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	Page
Some Economic Aspects of Fire-Protection Problems and Hazards in War Times, J. D. Pryor and F. V. Sackett	441
Oil Fuel in New England Power Plants, H. W. Ballou	450
The Workman's Home: Its Influence upon Production in the Factory and Labor Turnover, L. H. Allen	453
Manufacturing in Relation to Banking, Research and Management, W. Rautenstrauch	459
Man Power: Address at Meeting of Boston Section, J. Parke Channing	464
Correspondence	465
Revision of Boiler Code	468
Society Affairs	
Secretary's Letter	471
Council Notes	471
The Spring Meeting is On	472
Frederick Remsen Hutton	473
Tribute to John Porterfield Sparrow	478
Great Canadian Reflecting Telescope	478
The John A. Stevens Trust Fund	479
The Cullom Medal for Dr. F. H. Newell	480
Presentation of Edison Medal to Col. John J. Carty	480
Library Service Bureau	480
Among the Local Sections	481
The Providence Engineering Society and Its President	481
Section Meetings	481
Personals	484
Necrology	485
Roll of Honor	487
Candidates for Membership	487
Employment Bulletin	489
Engineering Survey	
Engineering News Items	493
National Foreign Trade Convention—Cotton Convention and Exposition—United States Railroad Equipment Standardization—War Department Bureau Created to Pass Upon Plans of Inventors—Testing the Relative Strength of Riveted and Welded Parts of a Ship's Hull—Interest in Use of Steam Meters in England—Pitch as a Steam-Boiler Fuel—Products derived from Corn Cobs—Rochester Plan for Supplying Shipyard Labor—Pig-Iron Interests Form Association—U. S. Bureau of Standards.	
Review of Engineering Periodicals	499
Miscellaneous	
Library Notes and Book Reviews	516
Advertising Section	
Display Advertisements	2
Professional and Educational Directory	50
Classified List of Mechanical Equipment	54
Members' Exchange	69
Alphabetical List of Advertisers	70

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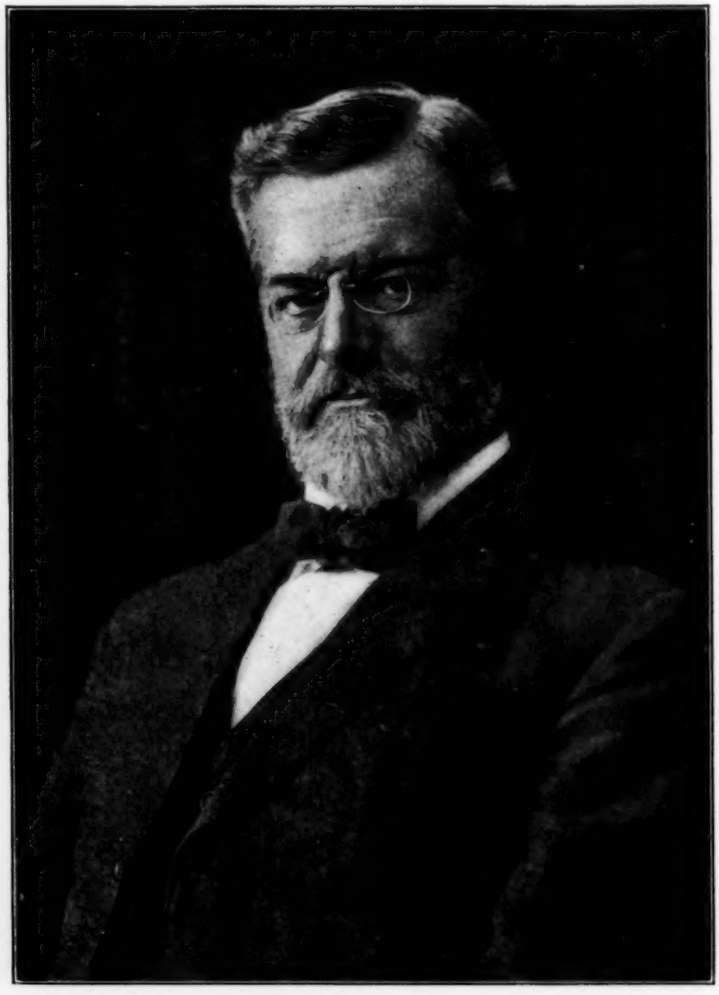

FREDERICK REMSEN HUTTON

DIED MAY 14, 1918

SECRETARY OF THE SOCIETY, 1883-1906

PRESIDENT, 1906

HONORARY SECRETARY FROM 1907

SOME ECONOMIC ASPECTS OF FIRE-PROTECTION PROBLEMS AND HAZARDS IN WAR TIMES

By J. DONALD PRYOR[1] AND FRANK V. SACKETT,[1] PROVIDENCE, R. I.

Non-Members

IN its essentials the fire-protection problem in war times does not differ from the fire-protection problem in peace times. It is true that war conditions aggravate and increase ordinary fire dangers, but the means found most efficacious for combating them in normal times are still most efficacious.

A great deal has appeared in the daily press on incendiary fires set by German agents, and the colossal amount of our fire losses last year—totaling as it did some $250,000,000, an increase of more than 25 per cent over normal—encouraged the belief that enemy aliens were responsible for the greater part of our staggering contribution to the fire Moloch.

Unquestionably, enemy agents did cause heavy fire losses—perhaps $30,000,000, but according to the National Board of Fire Underwriters certainly not more than this. If only about 10 per cent of our fire losses since we have been in the war have been due to enemy aliens, surely our attention should be focused on some means of stopping the remaining 90 per cent of the losses in quite as great a degree as it is on checking enemy spies.

The stationing of sentries outside of munition-manufacturing plants and other war industries appeals to the imagination of the public. It looks like real preparedness against the machinations of enemy agents, and it is, but as U. S. Attorney General Thomas W. Gregory says: "Statistics show that the chief dangers menacing private manufacturing plants are those which originate or are developed within their own boundaries. The real protection needed is protection within the plant itself, and the prime responsibility for the internal protection of workshops and factories rests, as it always has rested before, upon owners and managers."

What is really at the bottom of the present public interest in our fire losses is that our country for the first time is awake to the real meaning of fire loss. Before we entered the war, fire losses were regarded as a passing misfortune to individual business men, which misfortune they passed on to the insurance companies. And the public, business men in particular, shrugged their shoulders at fire-protection engineers and went on believing that fire-insurance indemnity was a panacea for fire losses.

Now the country is awake to the fact that a fire loss is no longer a private matter but a national consideration. They realize that insurance money is but a poor substitute for destroyed supplies. For the first time they realize that thinking insurance indemnity is a cure for a fire loss is just as sensible as thinking that German submarines are impotent simply because the ships they sink are insured. Faced with the task of supplying in great measure all of the sinews of war for the Allied cause, we have come to see that food and guns and machinery and clothing are themselves the valuable consideration, and not the amount of money they are worth.

Last year's increase in the fire loss is readily accounted for when we realize the tremendous speeding up of industry, the employment of unskilled labor, night-and-day operation and crowded storage, all of which have been part and parcel of our participation in the world conflict. Compared to other countries these considerations are those which have always made the fire losses of America the most amazing piece of wastefulness the world has ever seen.

In no country in the world has fire-protection engineering in the way of appliances for fighting fire, either manually or automatically, reached so high a degree of perfection as here. Nowhere in the world has fire-resistive construction been developed to such an extent as here. But in spite of this our fire losses, even in peace times, are staggering. In part this is due to our tremendous values. In some measure it is due to our large-area buildings and high-speed production, and in great measure it is due to our carelessness.

But at the present time our values are mounting higher and higher. Production is being speeded as never before. Surely the answer to our problem cannot be found by correcting either of these elements in the situation, for we positively must increase supplies and further speed up production. There remains for us only one way in which to effect the cure for this red disease which is sucking our resources; and that is to be more careful that fires do not start and more careful that we have at hand the means for putting them out when they do start, as some of them inevitably will.

The usual business building, be it manufacturing plant, storage warehouse, dock, pier or shipyard, is roughly classified by the insurance companies as being protected or not protected. It is a curious commentary that at present the three most essential classes of property in our country are those least protected. They are in order of their importance as follows:

a Shipbuilding yards
b Flour mills and grain elevators
c Piers, wharves, docks and storage warehouses.

There are two other great classes of vital industry—metal-working establishments, including foundries and machine shops, and textile mills, in which we have placed cotton mills, full-process knitting mills and woolen mills.

The average munition works, being a metal-working risk, has not the severe hazard of the foregoing classes of risk, and yet the fire loss among the metal workers is in itself astounding, and that industry, while its largest units fall into the protected class, has many small units where values have not to date been sufficient to induce owners to fully protect such property. Our textile mills producing clothes for our soldiers are the best and most completely protected class of property in this country, and probably in the world.

Fire Protection of Metal-Working Establishments and Textile Mills

Before passing to a consideration of the fire-protection problem of the three unprotected classes of essential properties noted above, it may be well to outline briefly the fire-protection equipment of the two protected classes of property, namely,

[1] General Fire Extinguisher Company.

For presentation at the Spring Meeting, Worcester, Mass., June 4 to 7, 1918, of The American Society of Mechanical Engineers. The paper is here printed in abstract form and advance copies of the paper may be obtained by members gratis upon application. All papers are subject to revision.

metal-working establishments and textile mills, and see what new demands the war has made on their fire-fighting facilities.

The increased hazard of fire in metal-working establishments has to do almost entirely with processes incident to their manufacturing ammunition, and a complete outline of the processes involved is almost essential to the thorough understanding of the new hazards involved. This whole matter was treated in detail at the 1917 meeting of the National Fire Protection Association, where a paper was presented by Mr. W. D. Milne, Inspector of the Underwriters' Bureau of New England. Except for one or two increased hazards in the treatment of steel, most of the new processes where serious hazards are involved are those having to do with the loading of the shells rather than with the making of the various parts, and those wishing to make a complete study of this matter are respectfully referred to Mr. Milne's paper, which will be found in the Proceedings of the National Fire Protection Association for 1917.

In conjunction with this paper on the manufacture of ammunition, Mr. Milne, in collaboration with Mr. N. Richardson, also presented some valuable suggestions on safeguarding industrial plants from labor troubles of various kinds.

As noted in an earlier paragraph, the ordinary fire hazards are still responsible for some 90 per cent of our fire loss, and consequently a consideration of the best type of protection against these hazards is of even greater importance than the consideration of means to overcome abnormal conditions due to the war.

Perhaps the quickest way to illustrate the comparative safety of most large metal-working plants from ordinary fire danger is to briefly review an investigation made a year ago in this class of property. That investigation showed that the average insurance rate paid by metal-working concerns, unprotected by automatic sprinklers, was $1.47 per $100, and that the average rate paid by these same concerns after having installed automatic sprinklers was 20 cents per $100, a reduction of 86 per cent in their average rate.

It should be remembered, however, that the requirements made by the insurance companies for sprinkler protection, which is the main dependence of all of these concerns, include certain other protection devices such as chemical extinguishers, oftentimes hose and hose connections and the installation in some cases of fire doors, the closing up of vertical openings, and, in many cases, the installation either of open sprinklers or fire shutters to guard the plants from exposure fires.

Since the insurance rate is invariably the truest measure of fire danger, it is readily apparent that these metal-working plants which have automatic sprinklers and other auxiliary protection are about as safe from the ordinary fire as it is humanly possible to make them.

The only danger from ordinary fires in these protected plants is that the fire-fighting equipment, either through carelessness or maliciousness, may become impaired, and in 1917 there were several disastrous fires in completely protected properties due to water's being shut off the sprinkler system.

The same type of protection that is enjoyed by these metal workers has been carried to its ultimate development in the great textile mills of the country, which were the pioneers in installing automatic sprinklers, and which are today enjoying rates on the average of from 7 to 10 cents per $100. They, just as the large metal-working establishments, are immune from ordinary fire dangers provided their fire-fighting equipments are kept in working condition.

As a further indication of how successful automatic-sprinkler protection has been in safeguarding metal-working risks and cotton mills, we refer to the sprinkler-fire records of the National Fire Protection Association. These records show that in 6412 fires in textile mills, 98 per cent were successfully handled by automatic sprinklers. Of the 128 fires which were classified there as unsatisfactory, 37 were due to the fact that the water was shut off the system and 57 to defective equipment or supplies and unsprinklered sections. These two causes, which obviously are not inherent in the standard sprinkler systems as installed by experts, can therefore account for about 73 per cent of the so-called failures in this great class of risk.

The same records show that in 1283 fires in metal-working risks, 95 per cent were successfully handled by the sprinkler equipment. Of the 59 fires which were classed as unsatisfactory by the insurance companies, 30 were due to the water's being shut off the system and 19 to defective equipments and unsprinklered sections, these two causes contributing 83 per cent of the unsatisfactory fires in this class of risk.

KEEPING SPRINKLER SYSTEMS EFFICIENT

These records show that unfortunately the fire-fighting equipments of these risks are not always in operative condition, and naturally the cleverly directed incendiary would take care to see that the sprinkler equipment was shut off, or otherwise put out of order before applying the torch. This danger of enemy activities, and also the fact that more unskilled labor than ever before is being employed in both these classes of industry, makes it particularly worth while to consider in addition to sentries and watchmen some automatic means of safeguarding their fire-fighting equipment, which equipment, in the last analysis, is automatic sprinklers.

The sprinkler-fire tables of the National Fire Protection Association show that out of 19,000 sprinkler fires in all classes of risk there have been 851 specified by the insurance companies as unsatisfactory. Of these 851, over 25 per cent, or 230, occurred because the water was shut off the sprinkler system.

As far as keeping the sprinkler service in all classes of risk in operative condition is concerned, and particularly as regards keeping the service intact in these special classes of risk, the most absolute safeguard is what is known as sprinkler supervisory service. This service is installed and maintained by the American District Telegraph Company and, briefly, consists of having the vital elements in a sprinkler system equipped with electric alarm apparatus, which automatically transmits a code signal to the central office whenever anything out of the way happens to the sprinkler system, in addition to automatically transmitting an alarm to the control station in case of fire.

For instance, as regards the matter of water being shut off the system there would be a switch placed on all controlling valves of the system, and if any of these valves, either through malicious intent or carelessness, were closed, the A. D. T. office would at once receive a signal of such closing and would immediately send a runner to correct the difficulty, or at least to ascertain if the owners were aware of the fact that their fire protection was impaired. The same general type of device can be applied to other elements of the system, but the mere equipment of controlling valves by protecting apparatus is one of the essential precautions which war conditions impose upon manufacturers who have otherwise adequately safeguarded themselves against having their production stopped and thus seriously interfering with the country's war work.

Where supervisory service is not available, or for financial reasons will not be considered, the importance of this matter

as evinced by the figures above quoted warrants the stationing of a man at any controlling valve of a sprinkler system which is closed for any reason whatever, and the keeping of that man there until the valve can be again opened and the system restored to service. Theoretically, if this stationing of men were religiously carried out this problem of closed valves and consequent heavy losses in protected properties could be avoided; but, unfortunately, the human element is such that this plan can never be considered as the ultimate answer to the problem.

The other chief causes of so-called sprinkler failures are generally defective equipment or water supplies and unsprinklered sections, these causes contributing 279, or 32 per cent, of the 851 so-called sprinkler failures in all classes of risk. For the most part, defective equipments are those installed before the present standards of appliances and installation were reached, and engineers should take care to thoroughly investigate the equipment in plants in which they are interested to see that it is in every way up to standard.

The matter of unsprinklered sections has always been a bothersome one, and it is particularly so in metal-working risks, because to the layman there are a great many sections of such plants where it seems almost impossible for a fire to start and gain headway. But it should be remembered that no man can tell when and where a fire will start, and that as far as the ordinary sprinkler equipment is concerned, an unsprinklered section acts to all intents and purposes as a severe exposure hazard; and at this time, when metal production is so necessary, every safeguard should be taken to see that such production is not stopped.

While it is true that the larger metal-working establishments, including automobile factories, are completely safeguarded by automatic sprinklers, it still remains a fact that there are a host of smaller establishments in this industry which are not so protected. The products of these smaller factories are often used in the larger, and patriotism demands that they should be protected against fire. Just remember that since 1908 nearly sixty million dollars in unprotected metal-working risks have been destroyed by fire, and the necessity of further protecting the smaller units of this industry becomes obvious.

SAFEGUARDING SHIPYARDS AGAINST FIRE

The war has once more made the United States a great maritime nation. We are planning to build more ships in the next few years than any other nation in the world, probably in mercantile tonnage nearly as much as all the rest of the world combined. So great has been the haste to rush shipyards to completion that in a great majority of cases fire protection, which is not a production but a conservation factor, has been overlooked. This is perfectly natural, but it is also extremely dangerous, because we must look at the ship problem not in terms of the money involved, but in the terms of the men we must put on the western front. It is estimated that it takes five tons of shipping per year per man on the fighting front. The destruction, therefore, of a shipyard capable of turning out 200,000 tons of shipping is just the same as if the Kaiser's troops had captured practically a whole army corps.

In general, there are two great classes of shipyards: (*a*) shipyards like the Bethlehem plant at Squantum, where the building ways and the slips are completely enclosed, and (*b*) the smaller yards where the ways are built in pairs with a runway between, and where there is seldom a roof over the ways, and practically never enclosing side walls. In the first type of yard the fire-protection problem is in most respects similar to the equipment of any large metal-working establishment or combination wood- and metal-working risk.

The more common type of shipyard, especially on the Pacific Coast and on inland waters in the eastern part of the United States, consists of office, storehouse, carpenter shops, etc., and where steel ships are being constructed, machine shops. These buildings are immediately above the ways and are usually of light wooden construction, generally one story high with a peaked roof, and sometimes a concealed space. The driveways and yards leading down to the shipyards are often planked.

The shipways themselves are close to the water's edge and are arranged in pairs, each pair being separated by wooden platforms or piers. These platforms on the land side are nearly the ship's depth lower than the completed hull, and a wooden stairway leads to an overhead platform or runway between each pair of ways. The timbering of the ways sometimes supports a light roof to protect the workmen, but the sides are practically never enclosed.

Obviously, this type of yard is a very serious fire risk, for almost invariably there is a strong wind blowing on the water and a fire starting at one end of the yard might well wipe out the whole enterprise in short order. Obviously, also, no scheme of protection can be devised which will invariably and infallibly protect such a plant, as it is impossible to expect automatic sprinklers to protect adequately the open-sided roofs of the ways where there is a roof, and sprinklers cannot be installed advantageously in the timbered runways.

The plan which has met with the greatest favor in safeguarding shipyards of this type is to run a large water main the whole length of the yard between the shipways and the buildings. The buildings are then completely sprinklered and feed mains are run from the large main down each platform, between each pair of ways, and hydrants are installed with an ample supply of hose so that fire on a burning way or ship can be fought from both sides. Usually two hydrants on the platform are considered sufficient. An improvement on this plan would be to install a standpipe with hose connection, which could be operated from the overhead platform above the lower working pier. This would provide vantage ground for fighting fires in the holds of ships partially completed without the delay of dragging a hose line up the stairway.

In shipyards where wooden ships are being constructed, and where consequently there is an enormous amount of lumber stored, the risk approximates that of the ordinary lumber yard. Such lumber yards should, of course, have adequate protection in the shape either of a complete hydrant system, or, better still, a system of standpipe monitor nozzles.

Briefly, this system consists of a series of standpipes about 24 ft. high, each carrying a monitor nozzle and a platform at the top. The standpipes are spaced about 90 ft. apart, and such spacing allows the nozzles to absolutely command any fire in the protected area. A ladder leads from the ground to the platform so that one man can quickly get the nozzle into operation, and by reason of a set screw direct it on the fire and then proceed to set another nozzle into operation, thus effectually attacking the blaze from several standpoints.

The initial water supply to this system can, as a rule, be taken from the mains which feed either the sprinkler system or the shipway hydrant system, but in addition to this there should be a fire pump taking suction either from city water, a reservoir or any other large supply such as a pond or river. The pump is controlled by a switch on the platform of the standpipe, so that after the primary supply has been started

there may be no delay in providing the extra pressure which such sweeping outdoor fires require.

At the base of each standpipe there is a post indicator valve which the operator opens before he goes to the platform. In connection with this valve there is also a drain which should always be left open when the nozzle is not in use, so that there may be no water left in the standpipe. This insures against freezing, which is one of the serious faults of the usual hydrant system.

The thought naturally occurs that the yards building wooden ships would be much more hazardous than the yards building steel ships. But this is not always the case, because the constant dropping of red-hot rivets in steel ship construction on the wooden platforms causes many fires and the underwriters feel that the danger is practically equal to the danger in the yards building wooden ships.

Obviously the various types of system above outlined for protecting the ways are largely dependent upon human activity, and the importance of the shipbuilding program would seem to warrant the yards in having specially trained men to handle their fire-fighting apparatus. We are not informed as to how far any of the yards have gone in this respect, but certainly if the hydrants are to be used most efficiently, any shipyard manager is shortsighted indeed who does not immediately organize and train his own fire brigade and install some type of manual alarm so that the men can quickly be summoned in case of fire and be fully instructed as to their individual duties in controlling it.

The fire brigades organized in a great many of the factories insured under the mutual system or with the Factory Insurance Association are extremely efficient, and no better plan could be followed by the shipyards than to adopt these same measures, because a lot of untrained men with a long length of writhing hose will succeed in making themselves ridiculous about as often as they will succeed in making the fire so.

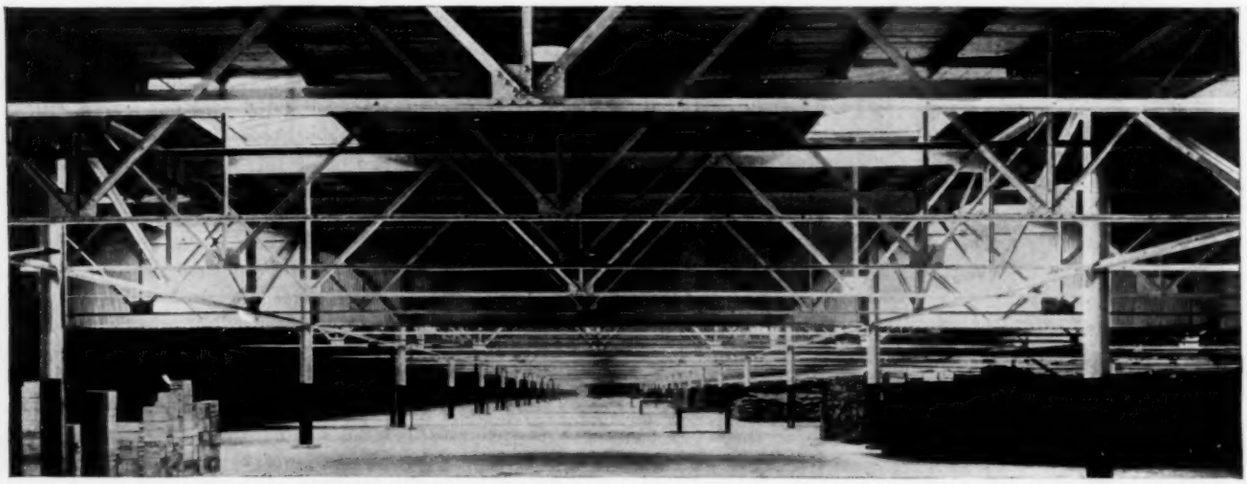

FIG. 1 A SPRINKLERED PIER IN BROOKLYN, N. Y. NOTE CURTAIN BOARDS INSTALLED TO BREAK UP CEILING AREA AND BANK HEAT AT SPRINKLER HEADS

FIRE PROTECTION OF FLOUR MILLS AND GRAIN ELEVATORS

Next in importance to the active prosecution of our shipbuilding program is the production and conservation of foodstuffs, particularly wheat. France and England are now on short wheat rations, and we ourselves have had to curtail our consumption seriously. But in spite of this tremendously grave situation, the National Board of Fire Underwriters declares that we burn up wheat in grain elevators and flour mills at the rate of about $10,000,000 annually, the total destruction of foodstuffs running to about $25,000,000 a year.

That this rate of burning can be very greatly cut down by adequate protective measures, the chief of which is automatic-sprinkler protection, is clearly evinced by a study of the sprinkler-fire records and by a comparison of the fire-insurance rates on such properties before and after protection.

The records of the National Fire Protection Association, covering 70 fires in flour and cereal mills protected by automatic sprinklers, show that in 54.3 per cent of the cases the fires were completely extinguished by the sprinklers and that in 37.2 per cent of the cases the fires were successfully held in check. Of the so-called unsatisfactory fires, making in all 8.5 per cent of the total, half were due to partial sprinkler installation or exposure fires, leaving only 3 fires out of the 70 where the type of construction was such as to handicap proper sprinkler performance, or where the hazard was too severe for the ordinary sprinkler system.

The same records show for grain elevators a total of 52 fires, 38.5 per cent of which were completely extinguished by the sprinklers and 32.7 per cent successfully held in check. Out of the remaining so-called unsatisfactory fires there were only 6 where the hazard of occupancy or the nature of the building was such as to make unsatisfactory the performance of automatic sprinklers.

This record shows why the average insurance rate on flour mills and grain elevators before the installation of automatic sprinklers and other protective devices is $3.03 per $100 and why after such protection it is $1.01—a 66⅔ per cent reduction. There is no doubt but that the hazards involved in this class of property are many and severe, not only as applied to the processes carried on, but on account of the general nature of the construction.

One of the greatest hazards in flour-mill operation is in the fast-running machines and in the processes of cleaning and reducing the grain. Nails and bits of wire are often drawn into the separator and cause sparks, resulting frequently in dust explosions. In this connection a report made many years ago is of interest. On May 2, 1878, the Washburn Flour Mills, Minneapolis, were wrecked by an explosion. A commission investigated and tested flour and coal dust. It was concluded

that "all finely divided carbonaceous material will explode."

The great number of elevators and conveyors running respectively vertically and horizontally through the plant make an enormous addition to the fire risk. The chances for fire to get a good start and to spread rapidly are so great that automatic sprinklers are placed somewhat differently from the method used in the ordinary factory building. The heads below the ceiling are spaced according to the usual standard, though frequently a little closer together. Around the elevators they are spaced as closely as they can be put without interfering with each other. They are also placed as near as possible to the elevator legs. The latter act in case of fire as veritable flues. To offset this an automatic sprinkler head is placed at the top of the elevator head inside the hood. The entire volume of water from this head would be discharged down the elevator leg and deluge any fire within it.

Freight and passenger elevators and stairways make another great hazard, and sprinklers are placed close to the elevator wells and under all stairways. Sprinklers are also placed at the top of the elevator shaft to protect the machinery, while the great number of nooks, crannies and other out-of-the-way places in such a building all have to be adequately protected.

The protection of the storage bins in the elevator section of the plant is a problem in itself. In cases where the bins are subdivided at the various floors, the same ceiling arrangement of sprinklers is adopted as in the mill building itself. In some installations, particularly where the storage is arranged in the form of silos, additional heads are placed beneath the floors of the silos, as well as in the space between the walls and the sides of the silos.

A considerable percentage of unsatisfactory sprinkler fires in this class of risk were made unsatisfactory by vertical openings or faulty construction. The maximum sprinkler efficiency cannot be expected where the automatic sprinklers are at a disadvantage with regard to distribution of water or rapid spread of fire, such as is produced by vertical openings, flimsy construction or concealed spaces sheathed in wood. All of these elements tend to spread a fire rapidly and should be avoided in every case possible.

An analysis of four-mill fires during ten years, made by the Millers' National Insurance Company, showed that just half of the fires proved a total loss, while the other half gave a partial loss. Seventy-three per cent of all fires occurred at night, 58 per cent of which were total losses; 71 per cent of the total-loss night fires were from causes unknown.

In spite of the fact that sprinkler protection obviously minimizes the danger of fire in these properties, and in spite of the fact that insurance rates are so largely reduced for such installation, there are, comparatively speaking, but few of this class of risk under protection. The very large mills almost invariably have such protection, as do the elevators in connection with them. But up to the present time economic considerations have prevented carrying this protection into smaller mills, country elevators and terminal elevators on the wholesale basis that the hazard and irreplaceable values at stake demand.

A great number of these smaller mills are located in sections where there is no adequate city water supply, and the consequent expense of tanks in connection with the equipment has worked to keep these properties unprotected; for business men seem invariably to demand that as far as fire protection is concerned they must be shown a very large and attractive investment through insurance savings or else they will not install the equipment. Unbelievable as it seems, there are few men who consider adequate fire protection a thing which they themselves can afford to pay money for out of their own pockets. They insist that the insurance companies to all practical intents and purposes foot the bill. Even with the necessity for installing tanks, sprinkler equipments in a large number of these mills would show the owners 6, 8 or 10 per cent annually on their investment, but this is not sufficient reward to induce them to make their properties safe from fire and thus help to conserve our food supplies.

In the country grain elevators the same condition applies as regards water supplies, and in addition the grain stored in the elevators is in many cases not owned by the same parties who own the elevator. Moreover it is usually stored for a period of only three to five months. This combination of circumstances and the seeming inability of the owners of the grain and the owners of the elevator to get together on a coöperative basis has worked to create a financial barrier against the equipment of these properties with automatic sprinklers.

As regards the great terminal elevators, the question is not one of water supplies, as these are in most cases available.

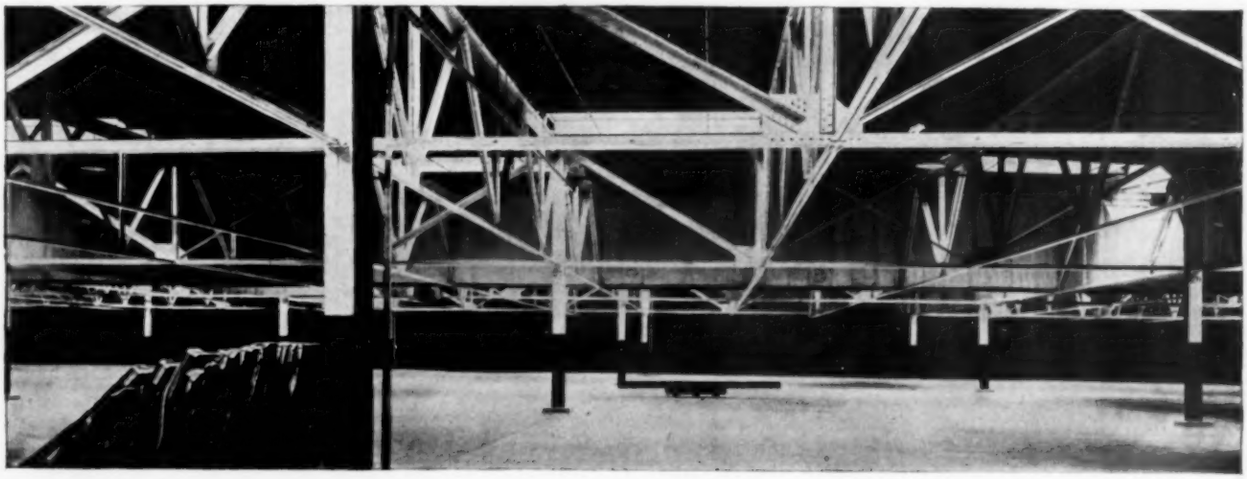

FIG. 2 ANOTHER VIEW OF PIER SHOWN IN FIG. 1. NOTE PARTICULARLY THE CURTAIN BOARDS RUNNING LENGTHWISE OF THE STRUCTURE

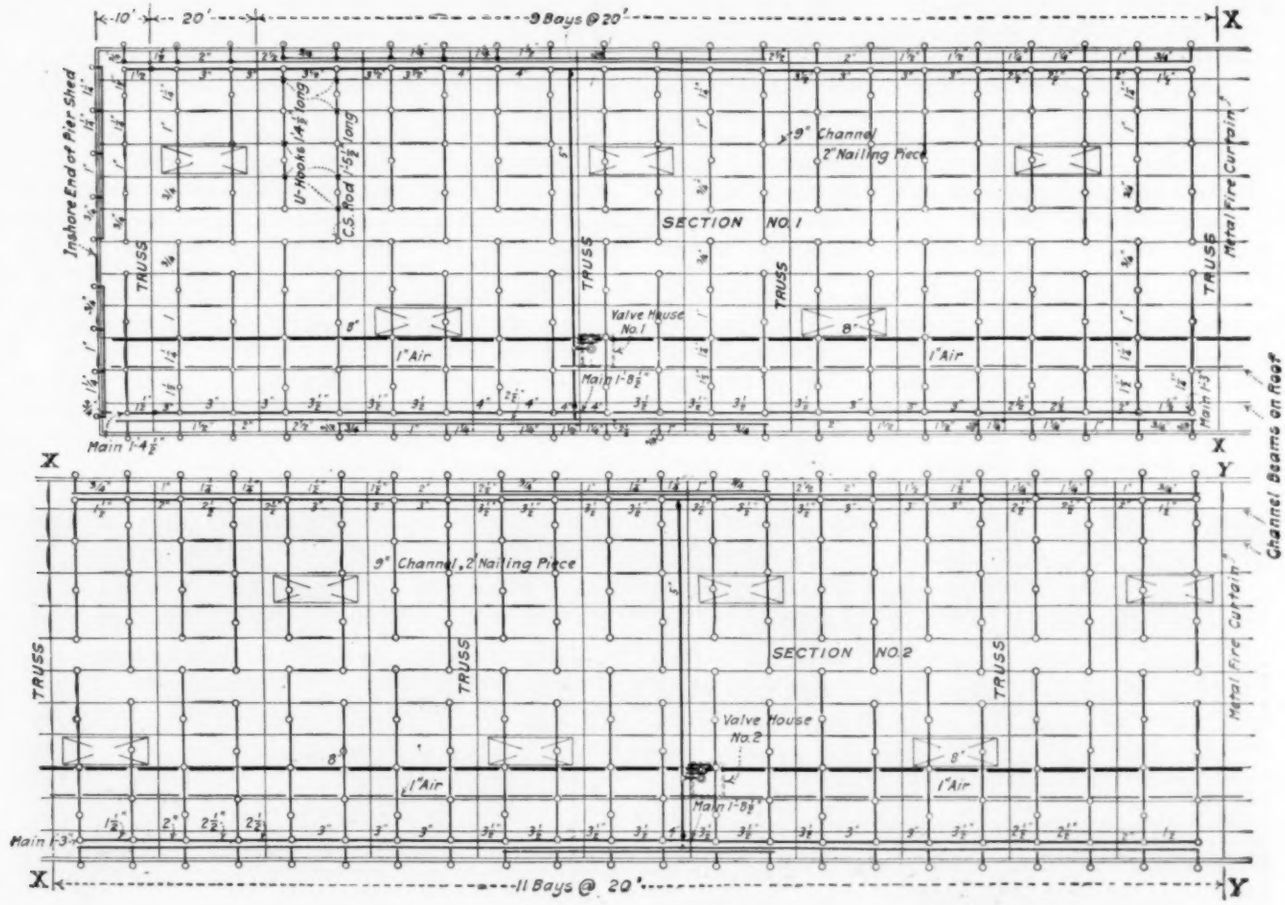

FIG. 3 SPRINKLER LAYOUT FOR A TYPICAL PIER PROPERTY (SEE CONTINUATION IN FIG. 4). NOTE PARTICULARLY THE OPEN SPRINKLER EQUIPMENT TO GUARD AGAINST EXPOSURE FIRES

Even where they are not, the values at stake are so great that the savings by reason of sprinkler equipment would pay for the systems in a comparatively short time. The trouble here is an exaggerated case of the same thing that exists in the country elevators, namely, that the elevator owners and operators do not own all the grain being stored or in process. Since the great value at stake is in the grain itself, and since owners of the grain cannot see why they should spend their money to improve an elevator which they do not own, enormous quantities of irreplaceable food values are at the mercy of fire in one of the most hazardous classes of risk.

While the engineering problems involved are a little more difficult than ordinary, they have been satisfactorily solved, and the protection of these properties is held up for financial reasons rather than on account of the engineering considerations involved.

SEAPORT PROBLEMS

Let us suppose, however, that there are no catastrophes in our great shipyards and that the country is successful in producing the needed ocean carriers. Let us suppose that the great ten-million-dollar-a-year fire loss in flour mills and grain elevators is stopped and that the grain is cleaned and milled and ready for shipment abroad. Have we then escaped all of the fire dangers which threaten to seriously impair our active prosecution of that part of our war work which has to do with feeding our Allies and providing supplies for millions of men abroad, including not only food but munitions, clothing, guns, aeroplanes, automobiles, etc.?

By no means. One needs but to visit any great Atlantic seaport today to see almost unbelievable quantities of supplies congested in piers, wharves and storage warehouses for shipment abroad. Our seaports are literally packed with vital necessities for France. No better idea of the fire hazards incident to such seaport congestion can be given than to quote from a book written by Fire Chief John Kenlon of New York, who perhaps has had more experience in fighting waterfront fires than any other man in America. Here is what he says of fire-protection problems in American seaports:

> The sheds or wharves, common to America, form about the most dangerous structures of their kind in existence. Built on wooden piles, with wooden superstructures, they are comparable to nothing but horizontal flues, through which flames rush with a lightning rapidity, rendering abortive any efforts on the part of the fire department unless the greatest promptitude is shown by all concerned, and demanding the use of fireboats with specially designed and extraordinarily powerful equipment. Fill these sheds with every sort of combustible material imaginable; hogsheads of resin, bales of cotton, crated furniture, barrels of pitch, stacks of dry goods, and such unconsidered trifles as a few boxes of celluloid toys and novelties, and can the mind of man conceive a collection of heterogeneous merchandise more calculated to provide the wherewithal for a conflagration and matter enough to assuage the thirsty pens of all the newspaper reporters in the town? Yet this represents an every-day condition in an American port, and it is perforce necessary not only to guard this property but to calculate the even more important risk, namely, should fire occur, the danger of its spreading to adjacent dwellings.

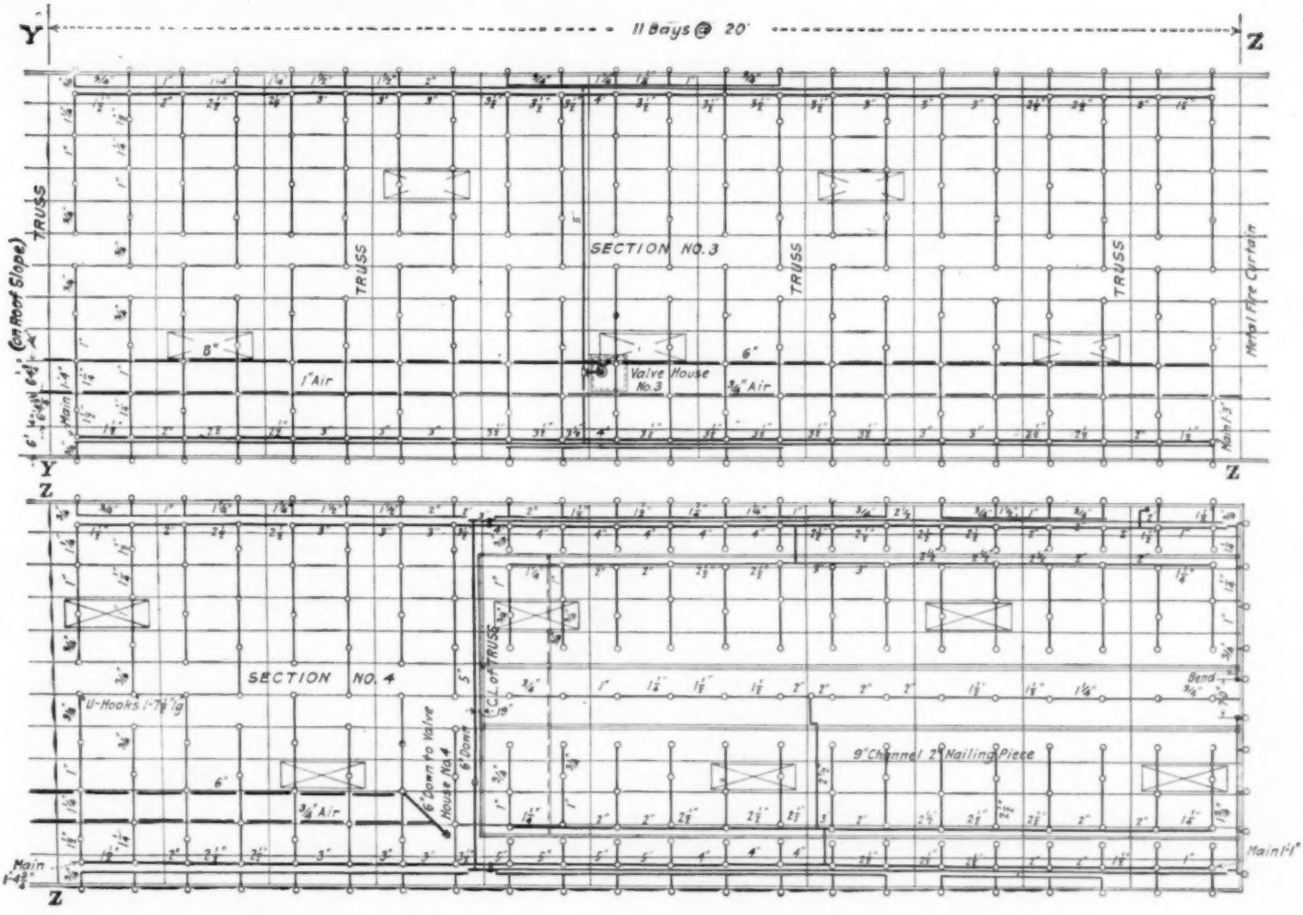

FIG. 4 SPRINKLER LAYOUT FOR A TYPICAL PIER PROPERTY—CONTINUATION OF FIG. 3

FIRE PROTECTION OF PIERS

The protection of pier properties involves special hazards which require special attention and constant following up, and on account of the extreme importance of this matter we outline briefly, in detail, the conditions found on piers.

Construction. Construction varies to a considerable extent, but in general the tendency of the past few years has been to improve the type of buildings used for this purpose. No doubt good construction would be of material assistance in safeguarding against the danger of fire, but, unfortunately, the present crisis will not permit of sufficient time to change existing construction defects. Frequently we find fire-resistive construction in the more modern properties, and a few sprinklered piers. Some are also found with fireproof floors and of slow-burning construction. In general, however, piers consist of one-story corrugated-iron buildings supported on wooden frames and wooden piles. Sometimes they are two-story buildings, but always with high ceilings and large openings in the sides for loading purposes. Almost invariably they connect by unprotected openings with adjoining bulkhead buildings of ordinary construction and considerable size.

Area. One of the worst features of piers is their large area, which is all open and subject to heavy drafts. Very seldom are these areas broken up by dividing walls, and unquestionably some good could be accomplished along these lines. For instance, fire breaks could be installed both above and below pier floors which would prevent the fire from spreading so rapidly and thus give the fire fighters a chance. Owing to the fact that piers are subject to heavy vibrations and movement, a great many could not be protected with standard fire walls, but fire breaks could help considerably and might be made of corrugated iron above the floor and heavy timbers below the floor, a construction which would not be affected by the movement of the pier.

Accessibility. From the very nature of piers they are less accessible than ordinary buildings. Their location near railroad terminals or on waterfronts means a frequent delay on account of congested traffic conditions. Furthermore, the ordinary building is accessible to fire fighters from all four sides, while piers are accessible only from one side, and that is always the short side. Approach from the water sides may be cut off by barges blocking the slips, and regulations should be made to keep these slips clear so that fire boats can approach from all sides.

Occupancy. The handling and storage of all sorts of supplies, from dangerous chemicals to aeroplanes, which must be received in whatever condition they are delivered by the transportation companies, is a dangerous operation. Furthermore, there is a constant change in the kind of material passing through from day to day, and this changing in itself produces a hazard, as elements that may be safe enough in themselves are frequently brought in contact with other elements which may cause them to be dangerous. Undoubtedly one of the worst features about this miscellaneous stock is the trouble with broken packages and containers, and the constant spilling of the various contents about the pier, where they may cause trouble later on.

Hazards. The lighting and heating hazards are about the

same as in the ordinary building, and apparently well taken care of, but, of course, they must be continually followed up.

SMOKING. No matter what regulations there are regarding smoking, it is a hard matter to handle. The danger from this source is always present, and the only remedy is to keep after the matter and treat offenders severely.

HELP. The scarcity of labor has resulted in the employment of undesirable and irresponsible help. It is a case of that or nothing, and certainly results in an increased hazard in handling. These men are not efficient, and are not trained in matters of fire protection as well as in ordinary times. There is no remedy for this condition except a careful and continual watching of these men.

EXPOSURES. Piers are subject to exposure fires not only from adjoining frame structures on land and other piers but also from vessels alongside and floating material from other fires in the vicinity. They are much more susceptible to exposure fires than ordinary property, because the high winds prevailing on the waterfront carry flying brands greater distances and fan these incipient fires wherever they start. An excellent illustration of this feature was the Jarvis fire on the Jersey City waterfront, which spread across the river to a pier in New York. The vessels alongside and in the harbor are also hazards, because the employees on board are careless about fire-protection matters and are not under restraint by the pier owners. Frequently boats containing dangerous contents catch on fire and they may expose several piers in the same harbor.

Fire Protection. Too much emphasis cannot be placed upon the necessity and importance of ample water supply for fighting pier fires, and yet during this last winter a large section of the Jersey City waterfront was greatly endangered by low pressure in the city mains. Reliable reports indicate that at the time of the coal shortage and very cold weather the city pressure at many points near pier property was *under 10 lb.* This danger was somewhat offset by good private supplies, but it simply indicates how bad things can get when not properly followed up. The size, location and condition of all mains and outside fire hydrants are matters that must have continual attention, or they are liable to fail during an emergency. Instances of this kind have already occurred.

INSIDE STANDPIPE AND HOSE. For instant use with incipient fires and to hold them until the fire department arrives, proper standpipe and hose connections are essential and are generally provided. It appears, however, that this form of protection is open to some objections not common in other property, namely:

a Subject to freezing, as shown by many cases that happened last winter

b Liable to be used by crews of boats alongside for purposes other than fire and damaged or left out of condition by them

c Frequently inaccessible or blocked by piling of goods too near hose racks

d Control valves are necessarily located out of reach, and when the operator finds the fire too severe he is liable to run without stopping to close the valve, allowing the waste of water when most needed

e Condition of piping where salt water is used frequently requires special attention on account of barnacles, pitting, etc. The only remedy for these conditions is constant inspection and frequent tests of the apparatus.

EXTINGUISHER PAILS AND CASKS. The value of this form of protection lies in the fact that every one knows how to use pails and casks, and if used in time they may save loss. They must be looked after frequently to see that they are ready for instant use.

WATCHMEN. This is one form of protection that means much or little, depending entirely upon the watchman himself. In the past the main trouble has been that men used for such purposes were not competent to fill the position, frequently being pensioners and others who were not physically fit. The importance of having strong, alert young men is becoming more apparent. When it is remembered that every night the entire protection of great value is solely dependent upon their good judgment and faithful efforts in a monotonous job, it will be understood that first-class men must be employed. It is also advisable to have a watchmen's checking system, and they must be thoroughly instructed in the detection and fighting of fire.

FIRE ALARMS. Both city and local fire alarms are desirable. The important thing is to give the alarm promptly upon the discovery of the fire, as assistance cannot be rendered too soon. For some reason or other there seems to be more trouble with delayed alarms in connection with pier fires than with other classes of property, and too much importance cannot be laid upon the necessity of early alarms for pier fires. Local fire gongs operated from the same box are desirable for the purpose of notifying all employees immediately, and furnish the best method of drilling them.

FIRE BRIGADE. A well-trained fire brigade is a very great advantage because these men are constantly on hand and available. Their jobs depend upon getting the fire out. Further, on account of their familiarity with the property and the fire-fighting apparatus they are able to get at the trouble very quickly. They should be under the direction of some experienced head and drilled regularly in their duties. They should know all about the apparatus and what to do in any emergency. They should be men selected carefully for their qualifications along this line. Surprise tests should be made by the owners frequently to see whether they are properly responding to alarms.

AUTOMATIC SPRINKLERS. The value of these systems is well known, and where properly maintained there is no question as to their efficiency. Pier conditions require special consideration, as follows:

a They must be dry systems because the piers are not heated

b High ceilings and particularly draft conditions make necessary curtain boards to bank the heat at sprinkler heads for high efficiency

c Extra heavy water supplies are required because of the large area subject to one fire

d Outside sprinklers are sometimes necessary to protect from exposure fires on vessels, etc., that may be alongside of the pier

e Sprinkler supervisory service for the purpose of automatically calling in the fire department whenever a fire starts

f Proper housing for mains and dry valves to prevent freezing during cold weather.

Considering the serious hazards in pier property, it is a surprising fact that only a comparatively few piers have been protected with automatic sprinklers. For example, out of some 150 piers in Manhattan we find only one or two with standard sprinkler equipments. Brooklyn makes a better showing with 18 sprinkler equipments, and New Jersey with about a half dozen. In the entire country there are only about sixty piers safeguarded with sprinklers.

We find that it is practically the unanimous opinion of all the fire-protection engineers that sprinkler systems afford the best possible protection for this class of property, and many

of them believe it to be the only satisfactory form for their particular conditions.

Mr. E. P. Boone, of the New York Fire Insurance Exchange, has had more experience with sprinklered piers than any one else in the country, and he is an enthusiastic believer in sprinkler systems for piers. His experience covers a number of actual fires which have resulted in only nominal loss to the property on account of the quick action of the sprinklers. He has mentioned one case where fire opened some twelve sprinkler heads which extinguished the fire so promptly that there was no interruption to business. Although the smoke was thick, the drivers continued to operate their motor trucks, loading and unloading as though nothing had happened. Figs. 1 and 2 give a good idea of the way Mr. Boone adapts sprinkler protection to the special conditions existing on a pier. Large open areas are broken into sections by special curtain boards coming down from the ceiling which bank the heat at the sprinkler head in spite of the drafty conditions. Note that some curtain boards are parallel with the pier, and others intersect them at right angles, running across the pier together, forming large pockets for the heat to rise in. This construction is rather unusual, and is made necessary on account of the extreme width of the pier. Fig. 1 also indicates the great length of the pier. These views show one of a group of sprinklered piers owned by the Bush Terminal Company, whose property was recently taken over by the Government. Figs. 3 and 4 show the sprinkler layout for a typical pier property, and Fig. 5 a section through pier indicating provision for a metal fire curtain.

Conclusions

Everybody's business is nobody's business, and we firmly believe that serious trouble will result unless the entire matter is handled in a businesslike manner by some high authority with broad experience in this line. We submit:

a That there should be no question as to the reliability of all water supplies involved, either public or private

b That lighters and boats exposing piers should be compelled to conform to established fire-protection practice and not be permitted to endanger this property by using kerosene lamps, cooking stoves, etc.

c That dangerous chemicals, oils and highly inflammable materials should be segregated and kept separate from other supplies

d That barges and boats should not be permitted to block up slips, preventing access to the sides of piers

e That extra large areas should be divided by section walls or fire breaks

f That explosives, or explosive materials, should not be permitted near the important terminals

g That bulkhead buildings should be cut off from piers wherever possible

h That sprinkler protection should be provided where conditions appear most serious

i That good, reliable watchmen should be employed at night to properly safeguard the contents

j That all dirt, waste and rubbish should be immediately removed and the premises kept scrupulously clean

k That, wherever lacking, all necessary fire-fighting apparatus should be provided and constantly tested and inspected

l That there should be a uniform practice established for handling all these matters, and particularly seeing that they are followed up from day to day.

In our opinion the desired results can be accomplished only in one way: The Government must create a special central authority, with necessary experts to make a complete study of the entire situation in all our seaports, and then place the responsibility of handling and following up such matters in this one central authority. It must be more than an advisory body, and should be composed of men with practical experience in such matters, and capable of enforcing the necessary regulations. This step is not only justified as a matter of business expediency, but is in reality a matter of military necessity.

We have sought in the foregoing to outline some of the broader principles of fire protection in essential industries, but in the last analysis each individual risk has its own particular problems which must be solved for the individual plant by the engineers in charge.

One thing that applies to all plants, all offices and all houses is the matter of cleanliness and carefulness. What this country needs is more careful national housekeeping, and in this connection the writer asked the Fire and Accident Prevention Committee of the National Fire Protection Association for a

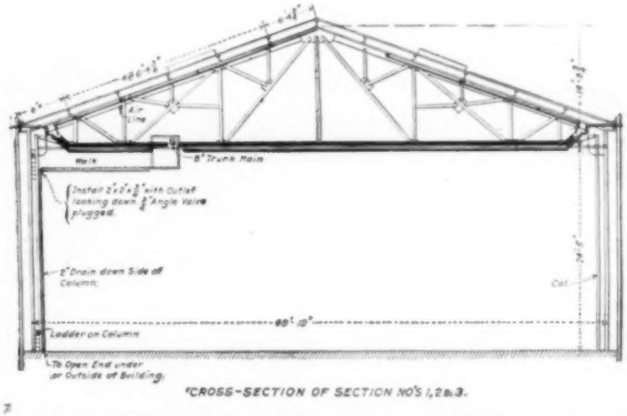

FIG. 5 SECTION THROUGH PIER OF FIGS. 3 AND 4 SHOWING PROVISION FOR METAL FIRE CURTAIN

brief outline of the work it is doing this year in trying to reduce the fire losses which are so serious a drain on our national resources. In reply they said:

"We plan to incorporate where possible, ordinances giving the fire department power to enter premises for clean-up purposes and to correct various undesirable features. We are at present formulating a program to include the education of school pupils in the details of fire prevention in the home, and to bring to the public a realization of personal responsibility for fires originating on their premises, whether homes or business.

"We are also arranging for parades and demonstrations and suitable literature through committees which are to be formed in various cities throughout the country. As to your paper before the Mechanical Engineers, that is an opportunity for you to place before them the great necessity for incorporating fire-protection features in their plans when they are called upon to outline any project. We must rely upon the engineers of the country to help us in the broader field, and where plants are being erected usually the first consideration should be the preservation of that property from fire. Their realization of this need will be a great help, not only in reducing the fire waste of the country but in preserving the necessary output of materials in this time of war."

OIL FUEL IN NEW ENGLAND POWER PLANTS

By HENRY W. BALLOU,[1] PROVIDENCE, R. I.

Non-Member

IN the New England states there has of late been a rapid increase in the use of oil fuel in power plants, and in a convention partly devoted to the fuel problem a brief statement of the present status thereof may be of interest.

From data privately gathered it appears that oil fuel is now used in at least 60 different power plants in New England, having a total of 83,000 boiler hp. These installations are located as roughly indicated on the outline map of New England shown in Fig. 1. They are grouped according to states as shown in Table 1, from which it may be seen that two-thirds of the power plants and over one-half of the boiler horsepower so served are in Rhode Island.

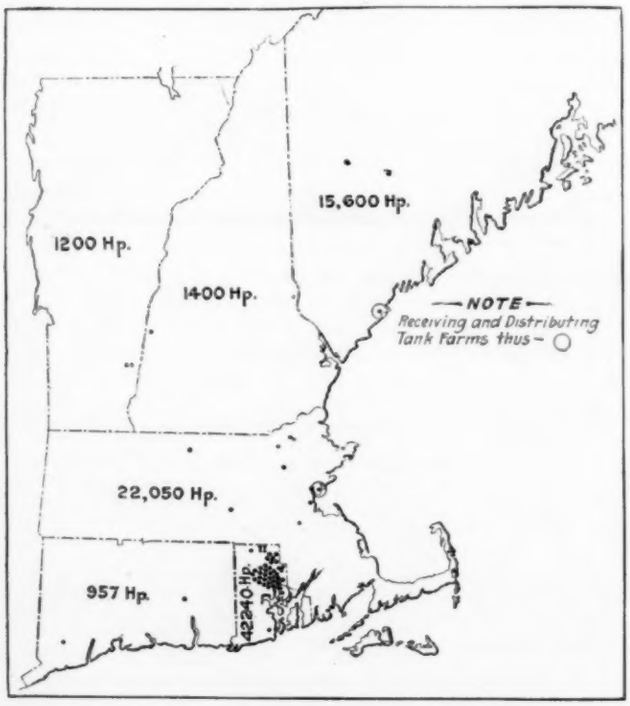

FIG. 1 DISTRIBUTION OF OIL-FUEL POWER PLANTS IN NEW ENGLAND, APRIL, 1918

As shown in Table 2, most of these installations have been made in the past three years. When classified as to type of boiler, the result is as given in Table 3. When classified as to make of oil burner in use, the data are as presented in Table 4. It is estimated that in the year 1917 about 95 per cent of all of the fuel oil burned in New England power plants was used through Hammell burners.

Oil fuel is supplied almost entirely by the Mexican Petroleum Company from three tank farms located at Providence, R. I., Chelsea, Mass., and Portland, Me., having capacities of 257,000 bbl., 165,000 bbl., and 202,000 bbl., respectively. It is said that tanks have been ordered to increase the capacity of the Providence tank farm to 735,000 bbl., which is roughly equivalent to 200,000 tons of coal.

All of this oil is brought from Tampico, Mexico, a distance of over 2000 miles, in tank ships. The size of these tankers has greatly increased of late, the largest running into Providence being nearly 500 ft. long and drawing nearly 30 ft. of

TABLE 1 NUMBER OF OIL-FUEL POWER PLANTS IN EACH NEW ENGLAND STATE IN APRIL 1918

State	Number of plants.	Total horsepower
Maine	3	15,600
New Hampshire	1	1,400
Vermont	2	1,200
Massachusetts	10	22,050
Rhode Island	42	42,240
Connecticut	2	957
Total	60	83,447

TABLE 2 OIL-FUEL POWER PLANTS INSTALLED IN NEW ENGLAND, 1915–1918

Year	Number of boilers	Boiler horsepower
1915	74	24,450
1916	79	14,315
1917	98	22,382
1918	93	22,300

TABLE 3 BOILERS INSTALLED IN NEW ENGLAND OIL-FUEL POWER PLANTS, 1915–1918

Number of boilers	Make of boiler	Total boiler horsepower
130	Horizontal return tubular	22,582
88	Manning	16,525
81	Babcock & Wilcox	31,025
15	Heine	4,400
15	Stirling	3,800
5	Scotch marine	715
4	Gunboat	2,400
3	Edge Moor	1,000
2	Keeler	500
1	Aultman-Taylor	500
344	Total	83,447

TABLE 4 OIL BURNERS IN USE IN NEW ENGLAND POWER PLANTS, APRIL, 1918

Make of burner	Number of plants	Boiler horsepower
Hammell	55	81,040
Witt	4	1,157
White	1	1,250

[1] Jenks and Ballou.

For presentation of the Spring Meeting, Worcester, Mass., June 4 to 7, 1918, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. The paper is here printed in abstract form and advance copies of the complete paper may be obtained by members gratis upon application. All papers are subject to revision.

water. Its capacity is 80,000 bbl., which is roughly equivalent to 20,000 tons of coal.

Local delivery from tank farms to power plants is by tank cars and auto trucks. Perhaps one-half of all fuel oil is delivered by auto trucks having capacities of from 1500 to 2280 gal. Such trucks, carrying 8 tons of oil, or enough to yield 2000 hp. for a 10-hr. day, will discharge their load by gravity in from 3 to 5 min. Oil trucks from the tank farms at tidewater in Providence make the round trip to the Tamarack power house in Pawtucket (a distance of 10 miles) in 1½ hr., including both loading and unloading.

The oil is usually delivered at a temperature of from 80 to 85 deg. fahr. The quantity delivered is seldom checked by weighing or by temperature observations, the "delivery slip" of the oil company usually being accepted as evidence of quantity, after observation by the purchaser's agents that the truck is full on arrival and is allowed to thoroughly drain. Analysis or other test of the oil is seldom attempted by the purchaser.

The chemical constitution and freedom from impurity of the oil appear to be remarkably uniform, especially when considered in contrast with coal. Uniformity is presumably favored by marine shipment in bulk. So far as known, there is no accumulation of water or silt in the receiving tanks at power plants. The small quantity of water in the oil, frequently about one-half of one per cent, is said to be present as a sort of emulsion.

The typical New England power-plant equipment is often about as shown in Fig. 2. Cylindrical steel tanks, of capacity to serve from a day to several weeks, are usually set in the ground or in concrete vaults. Concrete storage tanks are also extensively used. A steam coil keeps the oil in the tank at a temperature of from 90 to 120 deg. fahr., whence it passes through an ordinary duplex pump and thence to the boilers at a pressure of from 18 to 30 lb., being heated to perhaps 180 deg. fahr. by the exhaust steam from the pump. A return oil pipe discharges into the tank, thus providing warm oil at starting and discharge for the relief valve. Oil pressure is maintained by a pump governor, and meters on both supply and return pipes register quantities. Strainers, pressure gages, thermometers and twin pumps are customary. The simplicity of the typical oil equipment when compared with that for coal is, of course, one cause of the popularity of oil fuel.

Insurance requirements appear to have ceased to be burdensome as standards of fuel and equipment have been found to be uniform and reliable. At present the two main requirements appear to be that the tank shall be below ground outside of the building walls and below the level of the pumps and boiler-room floor. Even these requirements have been modified in some cases. No difficulty is experienced in pumping oil as warm as 130 deg. fahr. with a 10-ft. suction lift; and one installation with a 15-ft. suction lift is said to be successful.

A statement of the causes and conditions which have led to this sudden adoption of oil fuel in New England may be of interest. Of course, a primal cause was active propaganda by oil and equipment companies; and the basic cause was the superiority of oil to coal. The merits of oil fuel, however, although long recognized in other parts of this country, are somewhat of a surprise to the manufacturers of New England.

About nine-tenths of these oil-fuel installations are a substitution for coal in existing plants rather than primal installations in new plants, and it is believed that fully nine-tenths of them have been made without the advice of a consulting engineer. This statement may seem more significant than is really the case, both because in a number of instances where a consulting engineer's opinion has been sought the change to oil has not been made, and because of the excellent grade of engineering skill employed by the equipment companies in solicitation.

In general, the owner has been convinced by the remarkable contrasts between coal and oil, and the simplicity and freedom from labor troubles, ashes and dirt have appealed to him most strongly. In a number of cases additions to power plants have been avoided by the use of oil fuel, and such a feature is one to conjure with in New England.

There is no other method of increasing the capacity of a boiler plant so quickly and so cheaply as by substituting oil for coal fuel. Defective-draft troubles disappear coincidentally and the lone fireman dozes peacefully in ten-minute naps. In a number of cases the change to oil fuel has made it possible to shut down one or more boilers. The resulting saving

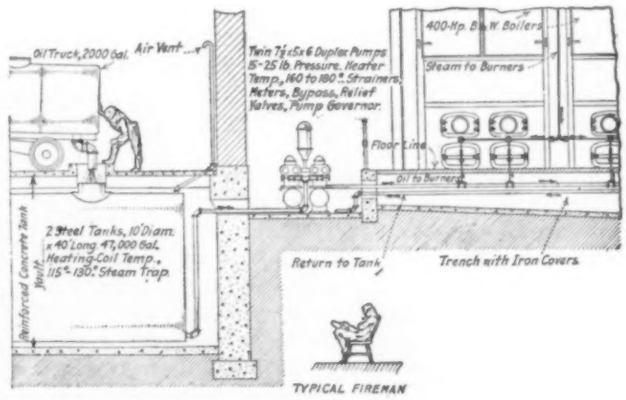
Oil Truck, 2000 Gal.
Air Vent
Twin 7½x5x6 Duplex Pumps 15-25 lb. Pressure, Heater Temp., 160 to 180°, Strainers, Meters, Bypass, Relief Valves, Pump Governor
400-Hp. B. & W. Boilers
Steam to Burners
Floor Line
Oil to Burners
2 Steel Tanks, 10' Diam. x 40' Long 47,000 Gal. Heating-Coil Temp., 115°-130° Steam Trap
Reinforced Concrete Tank
Return to Tank
Trench with Iron Covers
TYPICAL FIREMAN

FIG. 2 DIAGRAM OF OIL-FUEL EQUIPMENT TYPICAL IN NEW ENGLAND POWER PLANTS

in radiation losses and maintenance is a typical illustration of the collateral economies of oil fuel.

In the judgment of managers, the minor nature of alterations in a boiler necessary to use oil fuel and the possibility of readily changing back to coal are vital features.

A few plants in New England have accomplished the automatic governing of the flow of oil and of the atomizing steam. Hand control of operation is almost universal, and is now attaining a standard of excess-air proportions never reached even in the highest grade of coal plants, some tests having shown as little as 20 per cent excess air. It is inspiring to contemplate the probability that automatic regulation of the oil, the atomizing steam and the draft pressure will all become a standard reality within a few years. Then will be the golden age of regulated combustion in New England power plants.

The advantages of oil fuel are ably set forth in the TRANSACTIONS for the year 1911 in a paper by B. R. T. Collins,[1] in which there are formulated seventeen well-defined ways in which oil fuel is superior to coal. Papers by C. R. Weymouth[2] in 1908 and 1912 are also noteworthy, and the U. S. Navy tests of 1905 and of 1916 are excellent evidence, if proof were needed, that, per heat unit contained, oil fuel is from 10 to 20 per cent more efficient than coal.

In an excellent paper on fuel oil, read before the Boston Section of the A.S.M.E. in 1917, Mr. F. W. Ewing estimated

[1] Trans.Am.Soc.M.E., vol. 33, p. 83.

[2] Trans.Am.Soc.M.E., vol. 30, pp. 775 and 797; and vol. 34, p. 639.

that parity in the price of coal and oil is reached when 26 per cent more is paid per heat unit of oil than of coal. This would be equivalent to about a 60 per cent higher price per pound of oil. While noting that this generalization should not be taken too seriously, the writer is inclined to believe that the many collateral economies involved in the use of oil fuel cause it to be true that in numerous cases even more than 60 per cent extra can be paid for oil.

The saving of labor due to oil fuel as compared with coal, while in itself large, has often been given a greatly exaggerated importance. Of the operating expenses in a New England boiler plant other than fixed charges, 80 to 90 per cent are usually for fuel. Accordingly a slight variation in the cost per pound of fuel may amount to as much as the total cost of labor. It has been said that a variation of a tenth of a cent a gallon in the price of oil will offset all saving in wages due to oil fuel.

It is obvious to engineers that, assuming a dependable supply of oil fuel at a price per heat unit equal to that for coal, the latter would soon cease to be used in the power plants of New England. The choice between oil and coal is therefore a matter of supply and not of quality. The only way in which coal may rival oil fuel is in price. It accordingly becomes of interest to consider what the future may have in store for the power plants of this section.

A recent review of the coal supplies of the world by the National City Bank of New York sets forth the remarkable fact that the coal deposits of the United States exceed those of the rest of the world combined and are seven times as great as those of all Europe. Of these prodigious deposits a large part of the finest steam coals lie in the states of Pennsylvania and West Virginia, within 500 miles of New England.

As to production, in the year 1917 the United States mined within 10 per cent of as much coal as the rest of the world combined, over one-half of which came from Pennsylvania and West Virginia.

The greatest supply of coal in the world being within 500 miles of New England, what, now, is the case for fuel oil?

It is notable that the question of supply is not simply about *oil*, but about *fuel oil*, which latter has been defined as oil which is more valuable as fuel than in the form of refined products.

It appears that crude petroleum may be divided into two classes, namely, one with a paraffin base and the other with an asphalt base. That with the paraffin base is so valuable for its derivatives—gasoline, kerosene, lubricating oils, and a thousand others—that its price will always be prohibitive for fuel. Moreover, rapid improvement in methods of distillation has made the refined products from the lighter asphalt-base oils so valuable that many of these oils have disappeared from the fuel market. Much that was fuel oil ten years ago is no longer fuel oil. Thus it is that of the four great oil companies, each having extensive tank farms at Providence tidewater, namely, the Standard Oil Company, The Gulf Refining Company, The Texas Company, and the Mexican Petroleum Company, only the latter is furnishing fuel oil for power plants. Indeed, at the present writing the Mexican Petroleum Company is unable to take any more contracts for fuel oil, and on the face of things it appears that oil is even now more scarce than coal. The question is not as to the world-wide supply of crude petroleum, but merely as to that small part of the whole supply which may not be readily distilled.

The extremely heavy grades of asphalt-base oils from Mexico are practically the only fuel oils now available to New England. It will be shown later that this Mexican supply (amounting to 55,000,000 bbl. in 1917), though in itself of great volume, is destined to cut but a small figure in the world's supply of fuel. Consequently, Mexican fuel oil will naturally gravitate toward those uses for which it will command a premium.

The question then arises as to what uses will pay a premium for fuel oil, and the answer is, those uses in which its superiority to coal are most important. The greatest of these is marine use. Consider the item of labor alone. It is generally conceded that in a large boiler plant the boiler-room labor with fuel oil may be only one-tenth of that with coal. On shipboard the labor of coal passing and trimming bunkers greatly exceeds similar labor on land. When, as on shipboard, it becomes necessary not only to transport the heavier and more bulky coal but also to transport the laborer, his housing and keep, it is unquestionable that fuel oil will command a premium for marine use as compared with its use on land. The seventeen superiorities of oil fuel formulated by Mr. Collins apply with greater force on shipboard than on land. And the same statement is true in a slightly less measure in the case of locomotives as compared with stationary power plants.

The coal review of the National City Bank estimates the marine use of coal at 75,000,000 tons per year, or five times as much as the entire output of the Mexican oil fields. The Pennsylvania Railroad alone would take a large part of the total oil output of Mexico. Moreover, the relative ease of marine transportation of fuel oil will cause it to displace coal in places that are remote from coal deposits and difficult of access. Already, in 1917, over 3,000,000 barrels of this fuel oil went to the west coast of South America.

While prophecy is ever hazardous, it is probable that in the long run the use of fuel oil in New England will be confined to those special uses and sporadic cases which, for one abnormal cause or another, can afford to pay the premium that oil fuel will command for uses outside of power plants. Oil fuel will within a very few years become a luxury for power plants.

The kinds of power plants which may be warranted in paying the premium that oil will ultimately command for transportation uses might include those plants which must maintain banked fires for considerable periods, such as plants auxiliary to water power or boilers serving fire pumps.

The premium may also be paid by small, prosperous plants in cities where smoke, dust and dirt are especially objectionable, coal storage difficult, ashes disposal expensive, and the labor expense and managerial oversight disproportionately burdensome.

In a word, oil fuel is incomparably superior to coal; but that very superiority, together with its relative scarcity, will ultimately debar it from New England power plants.

Just at present the user of oil fuel is enjoying those benefits incidental to extreme labor scarcity and abnormal prices for coal, and the lucky few who happened to have long-time contracts are reaping a golden harvest; but these conditions are ephemeral. Doubtless the whole cost of many oil-burning installations will be saved well within a period of five years.

The present rapid increase in the use of fuel oil in New England power plants is but a lucky incident in the marketing of a great natural product. Immense as is its absolute volume, the insignificance of its relative volume as a source of world-wide fuel has thus far been the main obstacle to the adoption of Mexican oil on the high seas. That obstacle is rapidly disappearing, and, regrettable though it be, it is inevitable that its very virtues will ultimately deprive the power plants of New England of fuel oil.

THE WORKMAN'S HOME: ITS INFLUENCE UPON PRODUCTION IN THE FACTORY AND LABOR TURNOVER

BY LESLIE H. ALLEN,[1] BOSTON, MASS.

Non-Member

THE events of the past twelve months have shown up in no uncertain way many serious defects in the structure of our social system. So many things in which we prided ourselves and rested with confidence have fallen apart or shown essential weaknesses. The earnest efforts of all who have at heart the welfare of our country and its people are needed to redesign and reconstruct the defective parts of our social machinery in order that we may maintain the leadership of democratic nations that we now hold and enjoy.

Among the industrial and economic problems which have disclosed themselves and are pressing for an immediate solution is that of the housing of the working classes, the subject of this paper.

Let it be recognized at the outset that this problem is entirely distinct from that of the housing of the poor, a problem of equal urgency and of greater difficulty, a problem in which we all are, or ought to be, equally interested. In addressing The American Society of Mechanical Engineers in their professional capacity, I have, however, restricted myself to the subject of housing the working classes, a subject that bears an important relation to the professional work of the engineer rather than to his social sympathies.

The high wages that now prevail are not bringing to the workingman either wealth or comfort. The shorter hours that the unions have devoted so much time and effort to secure and have often fought for with so much bitterness have not produced any corresponding improvement in the workman's condition. This is largely because the workman is unable to secure a comfortable home in which to spend and enjoy his hours of leisure. If he earns high wages rents are raised by landlords generally and prices of other commodities go up in like manner, and in growing centers of industry houses are usually impossible to obtain. At the present time, when the cost of building is so high, new houses are not being built to accommodate the growth of population or its concentration in industrial centers engaged in munition work and shipbuilding, and the result is an altogether disgraceful amount of overcrowding. It is becoming the rule rather than the exception for two or even three shifts of men to occupy the same beds in overcrowded rooms, and it is practically impossible for any workman, skilled or unskilled, coming to a new town to bring his family with him; he has to come alone and crowd in as a lodger with others.

None of us have attended this meeting to discuss matters of abstract interest, and in addressing the members of the Society it is most important that the connection between the housing problem and their professional work be clearly established.

Lack of Housing a Frequent Cause of Labor Turnover

Recent investigations have shown that one of the most important causes of the present abnormal labor turnover is the lack of sufficient homes to house the population around industrial plants and the altogether unsatisfactory nature of such houses as there are.

It is hardly necessary in this paper to present figures regarding labor turnover to a meeting of engineers; it is a pressing problem that you all know more about than the speaker. Ten years ago we should have felt rather ashamed of a turnover of 100 per cent per annum. Many large plants now consider themselves very fortunate if they can get below 200 per cent. Those who do not keep track of their figures may be inclined to dispute this, but those who through their employment department keep records of their labor turnover will unanimously bear out the general statement made above.

The fact is, that in spite of high wages the living conditions in our manufacturing centers are so miserable that a workman cannot endure a long stay in one place, and he soon throws up his job and moves on to the next town for the sake of a change in the vain hope that he will find something better than the conditions he has just left. Such men separated from their families and roaming from place to place soon degenerate into the "floater" class that is such a big problem to our employment departments.

Results of a Questionnaire on Means of Reducing Labor Turnover

In order to bring out more clearly the importance of good and adequate housing as a means of reducing labor turnover, the Aberthaw Company has just prepared and circulated a questionnaire among employers of labor, asking for figures on their labor turnover and on the character and sufficiency of the house accommodations around their plants. Prior to this, as far as could be ascertained, no data had been assembled on this relation, although the opinion has been widely held that housing has an important influence on labor.

Eight hundred and forty replies were received, containing a mass of most interesting information. The replies were from typical plants in the eastern and middle-western states, some in cities and some in small towns, and may be taken as a fair average statement of conditions.

As we expected, only a small proportion (18½ per cent) of our correspondents kept any record of their "hiring and firing"; of those who had kept records on turnover nearly a third had started keeping their records within a year.

Very few of those answering stated that they housed all their help, but 17 per cent owned some houses.

In answer to our request for an expression of opinion as to the influence of good housing, nearly all replied that it was a benefit to a manufacturing plant, tended to hold the men and made them more contented and happier, but there was some division of opinion as to whether it reduced time lost through sickness.

The opinion is held by all manufacturers located in large cities, such as New York, Philadelphia and Buffalo, that in very large communities housing has no bearing upon labor supply—with the exception of one firm in Detroit, which attributes a large reduction in turnover to selecting its new employees from those who live within half a mile of the plant. No firm in a very large city shows any interest in housing, al-

[1] Aberthaw Construction Company.

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though in many cases the turnover is just as large. Whether this opinion is a correct one due to there being an excess of supply over demand for houses or for labor or both, in our big cities, or whether the opinion is fallacious, we are unable to say.

TABLE 1 RELATION BETWEEN LABOR TURNOVER AND HOUSING

Turnover	Percentage of localities reporting adequate housing	Percentage of localities reporting insufficient housing
Less than 50 per cent	52.5	34
50 to 100 per cent	21	35
100 to 200 per cent	14	14
200 to 300 per cent	7	6
300 to 400 per cent	3.5	8
Over 400 per cent	2	3

Table 1 has been compiled from the answers received. It indicates that over 50 per cent of plants reporting turnover which have adequate housing around them have a turnover below 50 per cent, while only one-third of the plants where housing is insufficient report as low a turnover as this.

Combining all plants reporting a turnover of less than 100 per cent, the figures are only slightly in favor of those which have adequate housing; above this point the advantage rests with the well-housed plants.

EXTRACTS FROM REPLIES TO QUESTIONNAIRE

The figures obtained cannot be called conclusive, and it is probable that many with records of high labor turnover did not care to disclose them. Of far greater interest and value are the replies returned with the questionnaire. Some of the more interesting follow:

A Pennsylvania mill has some very positive evidence of the cash value of good housing. Their manager writes us:

Our two blast furnaces are located about twenty miles apart, and between them is the blast furnace of a rival company. We consider our housing facilities superior to theirs, and to give you an idea of the effect of this would state that for years past they have had to pay more per day, of the same number of hours, for all of the men they employ around their plant. Of course the wages differ for different positions, but any position at their plant pays more money than a corresponding position at either of our two plants.

Furthermore the general living conditions around one of our own plants are somewhat better than the other, and in view of this we find we have to pay a differential in the labor scale although the plants are only twenty miles apart.

Hardly a month goes by that we do not get some men to come to us from this rival furnace, stating that the reason for moving is, though they get less wages, the housing conditions are better around our plants.

I might say that while we have not got the exact figures for comparison, we believe our labor turnover is exceptionally low compared to other plants in the same line of business, and we find the difference between the labor turnover at our different plants bears a relation to the desirability of the houses and living conditions at the respective plants.

A New Mexico mining company that has laid out one of the most charming and artistic villages owned by a copper mine, writes us:

When this camp was new, it was composed mainly of single men, the number of married men gradually increasing with the age of the camp until now a large majority of the men are married. This has necessitated the building of additional houses from year to year to take care of the demand, although there has been no material increase in the number of employees.

Without a doubt, a married man settled down in a house with his family is much more contented than a single man who is living in a boarding house. It is a fact that a married man will not jump up and leave his work on the slightest provocation, whereas a single man without a family connection frequently gets up and leaves without notice, for no reason whatever.

During the war period miners' wages are increasing rapidly, and in the very recent past there has been a great shortage of men. With the increase in wages and the shortage in labor, men have a tendency to want to move around from place to place to see if they cannot find something better. We have had a great many cases of men coming for the fourth or fifth time and giving us a list of fifteen or twenty places where they have worked in the past four or five months. During normal times we can safely say that an employee is more contented, happier and attentive to business when comfortably domiciled.

Indianapolis is a city we should all like to live in. Each manufacturer who writes from Indianapolis speaks of it as a city of homes. For instance, one letter says:

Indianapolis is a town where a great many workmen own their own homes. It is possible for a man to buy a piece of property in a decent part of the town with a good house on same by making a small cash payment and making the balance of his payments at about what he would pay for rent. We believe that this is a very good thing for the city, and for the industries and the men located therein. It has a tendency to stop the shifting and constant changing of men, and is of an economical value because it promotes saving and altogether produces a better grade of workmen and citizens.

It is our belief that there is not the great shifting among the workmen of Indianapolis that you will find in other manufacturing cities. At the present time we do not doubt but what the population is shifting more than under normal conditions, but we do not believe that this percentage of change is as large with us as it is in other communities.

A small Connecticut town of home owners seems well content, as one reply says:

A great many of our employees own their own homes, a factor which tends to hold the men, makes them more contented and happier and is evidence of an earning power greater than in many lines of industries, and the result is that we do not have to give any particular thought to housing conditions.

We all envy such a happy state of affairs.

From a thriving New York city the Broadhead Worsted Mills write us:

We have only three or four houses and do not believe in building houses for laborers. We have a class of labor a little above the average, who build their own homes. Jamestown is noted for its laboring people owning beautiful homes. When an employee owns his own home and is interested in the city where he lives he will stand by the company that employs him much longer than he will if he lives in a tenement house belonging to the company.

The experience of the general manager of one of our largest collieries confirms the views expressed. He says:

From close observation and study of results experienced at fourteen operating collieries, I can state specifically that where housing conditions excel there the better class of labor exists, as is demonstrated by higher efficiency in their work, cleaner play during their play time, and better homes for the wife and family.

At such of these collieries operated by this company and where conveniences of a modern character have been placed at the disposal of workmen and their families, our labor is of the most efficient and also of the most stable character. We have found under these good conditions that even though the man did not fully appreciate the conveniences provided, in a great many instances after he and his family had moved away the wife has written to our superintendents asking if her husband can be placed at work again, and if a house can be obtained. At other of our collieries, especially those acquired by purchase after housing plans had been fully developed under the previous owners, we have observed that where inadequate thought and consideration had been given to house plans and conveniences difficulty was experienced in retaining the desired class of labor, even though the

working conditions at the mine were equal to the working conditions at our collieries built throughout by ourselves.

Another colliery has had some interesting experiences to relate in keeping men by means of improving their houses.

Our company is engaged in mining bituminous coal, and has over one thousand houses. Owing to the depressed condition of the trade for many years we were unable to keep our houses in proper and attractive condition, and had it not been for that condition prevailing generally, we would unquestionably have lost labor that otherwise we retained. During 1916 and 1917 we put all of our houses in very much better condition and improved the surroundings. We have not any doubt that we have retained labor which would have gone to other places had we not done so, and our judgment is that it is wise to provide comfortable houses and attractive surroundings for the employees of any industrial establishment and that such a policy returns indirectly satisfactory financial results in the operation as a whole.

It is only fair to record adverse opinions. From a large te tile concern in Montreal we learn that company housing is a disadvantage to them.

It makes them independent; if the company had not built they would have built their own homes and become fixtures.

Mr. E. H. Barnes, superintendent of the large General Electric Co. works at Fort Wayne, Ind., writes us:

This is a town where a great many people own their own homes, or are buying them at the present time. After these have got located then the outsiders float in and out. Of course, with the abnormal growth of our concern in the last two or three years without any corresponding increase in the housing facilities the matter of overcrowding and indifferent housing naturally makes it rather difficult for people seeking a new place to work and live. Our ratio of people hired to those kept has run unusually high in the last year. This we find it impossible to analyze; as automobile and munition factories slowed up we probably got the result of their culling out dumped on us at that time, due to our geographical location, but we have no data to prove or disprove this.

The question of companies building houses and renting them to their employees is one which very few people seem to agree on. Personally I think that any company makes a mistake in doing this. The working people as a whole suspect some ulterior reason for the company's apparent beneficence. To the average American, who usually has very fixed ideas about these matters, it is more or less repugnant.

From another metal-working firm we have:

We know that good housing tends to hold the men, as we find that many men give their excuse for leaving us that they cannot always obtain the kind of a house they desire.

Another of our correspondents emphasizes the importance of employees living within walking distance of the plant. A Buffalo manufacturer's evidence is interesting.

We find that our most contented and steady, and probably best paid employees are those who live within walking distance of our plant.

Our main difficulty at this time in getting and holding employees is that the transportation problem would be largely solved by better housing conditions in the vicinity of our plant.

The opinion of Mr. A. W. Sanderson, Director of Labor of the B. F. Goodrich Company, Akron, Ohio, is doubly interesting because of the great outlay made on housing by the Goodyear Company in that city. Mr. Sanderson writes:

We have at times felt that if housing conditions were better throughout the whole city of Akron, turnover might be somewhat reduced, but we have never felt that any participation in the housing scheme would benefit us sufficiently to justify the undertaking.

Mr. R. S. Childs writes regarding the financial value of good housing:

At Marcus Hook, Pa., is the Viscose Company, makers of artificial silks, with a pretty housing development which takes care of about one-half of the employees. They have a labor turnover of 15 per cent per month at the present time. Next door to them is the Congoleum Company, making floor coverings, with no housing and the turnover is 30 per cent per month. The Viscose Company employs a larger proportion of skilled labor than the Congoleum Company. Living conditions in that region are very bad and labor is very restless, due partly of course to the great shipyard developments. The Congoleum Company recognizes the need of housing as the only solution of their manufacturing problem and figure they would save $200,000 a year thereby, inasmuch as they have unskilled labor handling fragile goods where a careless sweep of the arm will ruin $20 worth of goods.

Further confirmation from an Erie Iron Works:

Among our mechanics who own their own houses the labor turnover is very small; this also is true to a large extent among the unskilled labor who have lived in the city and own their homes.

The president of a large paper company near Philadelphia testifies to the steadiness of home-owning workmen:

Our industry is the principal one in the town and most of our employees have been with us for a great many years. There seem to be enough houses in the neighborhood to provide room for all. The company owns some land which it sells to those employees who want to buy and build their own houses. We sell the land at a low price and on any terms which the purchaser may desire. We encourage our employees to buy their own homes, as our experience is that those who do so are much more dependable than those who do not. Our relations with our men have always been most pleasant and all of them take a personal interest in the property and success of the business.

Another Massachusetts textile concern is desirous of seeing his men home owners independently of his company:

As a general proposition there is no question but what good housing near the plant is a benefit to any manufacturing business located in the country. We are under the impression, however, that good housing built by other people is of more benefit to the community and the manufacturing plant than housing controlled by the manufacturing plant itself. We are continually having to build more tenements, although we find that tenements owned by other people usually rent more readily and for more money than our own houses.

There seems to be distinct desire on the part of our better class of employees to spread out and not house themselves as thickly as in years past. Among some of the Southern European aliens, however, the tendency to overcrowd still persists.

We believe that a plan that enables the employee to build and own his own house is a benefit to the community, to the employer and to the employee. We have not, however, been successful in interesting our employees in any proposition of this kind to the extent we have desired.

A well-known crane manufacturer believes in selling houses to his men even at a loss:

From the fact that nearly all of the company capital is needed in its business it is a very difficult matter for them to divert much of it to the construction of new houses, much as they would like to do so.

We find that the employees were very anxious to buy these houses, but of course, the burden of the expense will have to be carried by the company for approximately ten years.

We consider it desirable to have as many of our employees own their homes as possible, because it makes them more thrifty and their families are better satisfied ordinarily, because of the added interest.

The pressure of the housing situation is very apt to make it necessary for us to utilize women in the shop to some extent. The fact that they are already housed makes it easier to use them than to get help from outside sources and then have the housing problem get more serious than it is at present.

While we have no definite statistics relative to the time lost by men who are properly housed and those who are not, we are of the opinion that a man working to pay for his own home will not lose any more time than is necessary and therefore will be on

the job as steadily as it is possible for him to be. The satisfaction of owning one's own home and improving it is real. So far as we can recall we have only had one man who has bought his home leave the employ of the company in the past three years.

The houses which the company built during the past year were sold to the workmen for considerably less than the actual cost of them; however, the difference between the actual cost and the selling price of the houses will not be lost in the long run, because we feel that the men will be better workmen and will stay longer with the company because of the situation.

Many can sympathize with the following frank admission:

We were of the opinion that it would be beneficial to house our employees located in good houses in the village, and bought a large tract of land with that end in view, but gave it up for a bad job and have not done any building of that nature for some time, and would be glad to sell all we own or to hear they were burned up.

Our correspondent did not enlighten us further. In face of the successful work done by other concerns we suspect that some initial error was made in the organizing of the project. Such a letter only emphasizes the need for careful organization and management in a housing development.

Mr. D. H. Andrews, President of the Boston Bridge Works, lays stress on the laudable desire of the workman to make his own home arrangements:

For the great mass of people human welfare seems to consist largely in comfortable, healthful homes with income enough to provide food, clothing and some provision for the future, with a reasonable amount of recreation. The undisturbed possession of comfortable, healthful homes is such a prime factor in the contentment of employees that every far-seeing employer should and would, if circumstances will permit, have a deep and personal interest in this phase of the welfare of employees. Our experience with employees is that generally if the location of their employment will admit of it, they prefer to settle the question of their homes independent of any consideration which may, to them, savor of paternalism on the part of their employers. If the employment is of stable permanence and the employer can provide homes for employees with an arrangement for the gradual rental purchase of same by the employee, that would seem to relieve the laudable sensitiveness of the employee and to promise the best solution of the housing problem.

This can be done in a big metropolis. It is not so easy in the smaller towns.

Another believer in company housing anxious to "control" his men writes from Pittsburgh.

We have a great number of plants. We don't attempt to house all our men at the plants, because they are all located near small towns, and a certain number of them are drawn from these towns, but we house as many men as we can near the works and are building houses just as fast as we can get employees to rent them.

We find it is best to have employees live near the works, and if you have them in your own houses, you can control them better. During the shortage of labor which we are all now experiencing, if we did not have houses near our plants, in many instances we would have been shorter of labor than we now are.

At one of our factories where we employ between two hundred and three hundred laborers, we house the majority of them. We have built practically the whole town.

As a general proposition, the writer has handled large lots of men direct for the last thirty years, and would, if possible, house every man on company property.

A contented Maine textile concern says:

We have been building a few houses every year or two and almost never lose a well-housed family.

An Ontario manager writes:

We think that no one at this time could deny the advantage arising from the possession of houses in which employees could be taken care of.

Unfortunately we haven't any residences in which to house our men, and the fact that we haven't operates against us because the town is crowded, and the first thing an out of town mechanic asks in answering our advertisement is about housing facilities.

This experience is borne out by a Connecticut metal worker who is building houses:

Not to house my present force—they are already located, but to add to my force by bringing in out-of-town men. They will not come unless I can find a home for them.

The general restlessness of labor is emphasized by many; for instance, Mr. F. R. Still of the American Blower Company, Detroit, Mich., writes us:

Proper housing conditions have a very decided influence on the turnover of the employees in any industrial institution. The best indication that this theory is a fact is demonstrated by plants located in very small places, where the rents are low or employees own their own homes. In all large cities where industrial institutions are numerous and mechanics are in great demand due to the scarcity of first-class mechanics, temptations are held out to the employees of first one institution and then another, which has a very decided influence in causing a spirit of unrest that leads to frequent changes of position, and it is hard to determine whether this is the deciding influence of the fact that housing facilities are adequate.

Undoubtedly if the employees in one institution have cheap rent or own their own homes, they are less inclined to move to some other institution, if the work and factory conditions are satisfactory. On the other hand, where rents are increasing from 25 to 50 per cent each year and the cost of everything is rising more rapidly than perhaps their wages are rising, they are naturally inclined to become restless and look about for positions that will pay them more than they are receiving at their present positions.

This view is indorsed by a machine shop in Providence who write:

We cannot attribute the labor-turnover problem which we experience to lack of proper housing. It is due in our particular case largely to a spirit of unrest. The operatives in our line seem to feel that they cannot work in one shop but about so long, and have to move along to a competitor, and finally come back to the old stamping ground for a period preceding another cycle of similar nature.

We are located in a community where good houses are available, and quite convenient to the plant. The company has not felt it necessary to consider entering into the house problem on its own responsibility, for this reason.

In our particular case, we doubt very much whether any house could be built that would hold our help beyond a limited period, unless it were a portable house.

A Buffalo textile firm says:

We have a splendid organization, and while there is considerable changing amongst our employees, particularly the girls, we think it is due to the existing unrest amongst the laboring class. Most of our employees live in the immediate neighborhood, and about 60 per cent of our entire staff has been with us ever since we located here in 1913.

The living conditions in the immediate vicinity of our mill are splendid, and we believe that this is one of the main reasons why we haven't experienced a labor shortage to any extent.

We, of course, realize that our possibilities of getting new and additional help are not as good today as they were when we located here; on the other hand, we have never been handicapped to any extent on account of being unable to secure employees.

In our estimation, good housing facilities have a tendency toward holding men that are married particularly; and the loss in time through sickness that our men have sustained is so small that it is not to be taken into consideration.

Mr. W. H. Ham, Manager of the Bridgeport Housing Company, comments on the prevailing "restlessness" and has some important and interesting suggestions to make.

Labor is restless at the present time. The single man is bound to be a rover. The young married man is somewhat better, but still has a tendency to rove and to seek better conditions and better wages because of lack of ties. The unmarried man should

be free from any restraints which would handicap his ability to advance himself. My feeling is that the best way to prevent roving of the harmful type is to build up the associations in manufacturing towns to such an extent that the unmarried man may have membership in proper kinds of associations, which will teach him to advance rather than stay still. Sports for both winter and summer are very important items. Winter sports are very lacking in most of the manufacturing cities. The competition in physical exercise is very keenly appreciated by the average working man.

I believe in the school for advancement of knowledge in the trade and the wholesome surrounding of a sufficient number of playgrounds so that we can have athletics for a very much larger number. This will have a great deal to do with the turnover of the unmarried man in the factory.

I believe the turnover among the married men with small families can be prevented by building attractive small homes (with emphasis on the adjectives that modify "homes").

A Philadelphia general manager attributes much turnover to errors in employing unsuitable men, stating:

It is the young, shiftless, irresponsible class who make the greater number of changes. Labor should be carefully selected and must be tried and culled in order to secure reliable workmen. I do not believe that any system of investigation will entirely or even largely prevent the misfits and dissatisfaction which frequently occur. A trial seems to be the only method for determining the matter finally.

This view is endorsed by the industrial superintendent of the Brown & Sharpe Manufacturing Co. Like all big city men he disregards the housing problem. He says:

The increased turnover in 1917 is due to military service and war conditions and has no relation to the housing question.

The main part of our experienced force has been stable to as great a degree as could be expected, the greatest turnover being among new and inexperienced help "hired out" to increase our force.

A Newark foundryman feeling the shipyard competition writes:

It is the shipyards that have made these men unsettled and continually dissatisfied.

The big wages paid by them have hurt many smaller manufacturers.

In the big centers the employer does not consider housing such an important element. From the Laboratory of Thomas A. Edison, Orange, N. J., Mr. Clark writes:

The Edison interests do not attribute any of their labor turnover to lack of proper housing. We are so situated that we draw our employees from a very thickly populated district, which does not make it necessary for us to house any of our employees.

Particular emphasis is made to the lack of proper housing at this time. This is due to the war work factories and shipbuilding plants that grow up over night. In these cases it is not a question of housing, it is purely a question of who pays the highest wages. The large labor turnover at this time is due entirely to what I might term competitive bidding for men's services, and the housing conditions are unquestionably a secondary consideration.

A well-known cement company is of the same opinion:

All of our plants with one exception are so located that a large proportion of the employees live in adjacent cities or towns. The plant which is the exception has the largest turnover of labor that we have and we are now building some houses we hope will better conditions.

An Empire State manufacturer has discovered another reason:

Adopt national prohibition of the liquor traffic, and many of the labor problems will solve themselves. Thousands of derelicts will never again be available to help do the world's work.

We suspect that the wish here is father to the thought, but we trust that if the drastic remedy is administered it will produce the expected cure.

Mr. R. L. Caldwell, well known to all interested in good housing, compares our care of our workmen to our care of our tools—to the disadvantage of the former:

Undoubtedly no class of Americans are more progressive generally than employers. They are keen for the quick adoption of any improvement in machinery, in facilities, in methods. Why is it that they are so slow to cultivate better relations with their employees, upon whom much more depends than on any machine? It cannot be because the question is difficult, for difficulties never deter an habitually successful executive, whose success lies largely in his ability to overcome difficulties.

Employees are very watchful of their machinery and take every precaution for its preservation and lubrication to insure its being maintained in good working order.

What would an employer think of a superintendent who scrapped 50 per cent or even 15 per cent of his complement of machinery per annum? Yet that this record is common in labor turnover is evidence conclusive that lubrication is needed in relations between employers and employees. To scrap workmen is expensive as every employee knows. New help is poor help. Inexperienced labor is inefficient labor, therefore costly labor. Low production per operative and per machine due to poor operatives means high costs in addition to low wages, so neither side is satisfied. Dissatisfaction results in more labor turnover and so the process continues interminably.

Here is a manufacturer in trouble. He states:

Our problem is housing single foreigners, who are more or less transient. They keep no heat during the day, freeze all water pipes, live without furniture, and have wrecking parties occasionally. Have suggested heated barracks with common lounging room, kitchen and food store, but they do not favor this on account of group likes and dislikes.

Experiences like this are common where proper regulation and inspection is not carried out. But the experience of the Octavia Hill Association and many others shows that even in the worst localities tenants can be made to live decently and treat houses properly.

Causes of Labor Turnover as Shown from Replies

The general impression gained from a study of these and many other letters establishes the following causes of labor turnover today:

1. Improper or insufficient housing
2. Inadequate transportation
3. The general restlessness due in part to the abnormal war conditions
4. "Misfits"—lack of care in employing men for work for which they are best fitted.

An important cause not touched on by any of my correspondents is the lack of proper relations between employer and employee, under which heading I would include lack of supervision of the hiring and firing of men, lack of care or interest in the men, friction with the labor unions, etc.

We cannot state definitely which of these is the most potent cause of trouble; but enough has been said to justify the statements made in the earlier parts of this paper on the supreme importance of good housing.

The lack of good and sufficient houses is now recognized as a most important hindrance to the winning of the war. Because of it factories are losing men, losing work, losing output and losing profit. Losing men, because they will not stay when houses are unsatisfactory; losing work, because in many cases work has to be refused because of lack of help, and also losing output because of lack of men—and loss of efficiency in breaking in new men is a serious factor in limitation of output, and losing profit because of all these.

A START ON SOLVING THE PROBLEM

During the last six months this is being very generally admittted, but little has been done to remedy conditions. Speculative building and real-estate development have practically stopped and the manufacturer confronted with rising costs and war taxes has pleaded his inability to release capital for extensions like housing work, which do not show any direct profit. As a result strong pressure has been brought to bear upon the Government to provide funds for housing, which has resulted in $50,000,000 being allotted to the Shipping Board and $60,000,000 to the Department of Labor for improvement of housing and transportation facilities around shipyards, munition plants and the like. In England since the beginning of the war $700,000,000 has already been spent and the future housing program in England runs into millions more, although the English housing problem has never been so urgent as it is here. It seems probable that the $110,000,000 with which the Government will initiate its housing program will be but a small part of the capital that must be invested by federal or state governments or by municipalities and manufacturers in the near future.

THE WORKMAN'S HOME: HOW IT SHOULD BE BUILT.

One of the striking things that investigation of housing conditions brings out in almost any city, is the unsuitability of the type of houses to the inmate. It seems that houses are hardly ever built to suit the needs of the working man, but those above him in earning power or standards of living. When such houses become dilapidated or neighborhood conditions change he enters the houses and adapts himself to them as best he can. Comparatively few workingmen need a six- or seven-room house or can afford to occupy them without subletting half of the house or taking lodgers.

Some of the worst housing conditions we find are in old mansions left stranded by the receding tide of fashion and now occupied by four or five families, all sharing the same toilet and water supply.

The experiment is now being tried in many localities of building three- and four-room apartments, and four- and five-room houses with much success. The workman as a rule does not desire to have the privacy of his home invaded by lodgers and welcomes the opportunity to live in a small house or apartment without them.

Any discussion of the kind of house he requires should be prefaced by a statement drawing a distinction between the skilled workman and the unskilled. The former are usually Americans or live according to American standards; the latter are mostly foreign-born or negroes, receive lower rates of pay and do not desire, or if they do desire, cannot afford all the refinements and conveniences that are usually built in the American home.

I have been criticized for emphasizing this; particularly by those who are working for the Americanization of the foreigner. I sympathize with those who seem to see in my suggestions a lowering of the American standards of living, to which all should aspire and eventually be raised, standards that I endorse and ideals that I stand for also; but I stand my ground, realizing that the goal we aim for cannot be reached at one bound, and if we insist on building only that type of house which we think is ideal we shall be of no help in relieving the wretchedness of the present generation of unskilled workmen and their families. They may look with longing at the accommodations being built for them but they cannot afford to enjoy them and have to be content with the overcrowded tenements and old houses of divided occupancy that they now live in.

There is a certain minimum however that we all agree should govern the design of any workman's home. He should have at least one living room for general use of an area not less than 150 sq. ft. entirely separate from his sleeping rooms, and he should have enough bedrooms for himself and for his children of different sexes to sleep apart, each bedroom having at least 400 cu. ft. of air space per occupant, and every room having direct sunlight and ventilation through windows of ample size. Every tenant should have his own private toilet equipped with water closet and bath tub, and a sink with running water in the kitchen; and all plumbing should be connected to the sewer and pure water for drinking be supplied through faucets in the kitchen and bathroom.

American standards demand in addition separate parlors, separate dining rooms, pantries, large cellars, porches, furnace heat, electric light, laundry tubs, lavatory bowls, etc. All these are desirable and should be provided if possible, but it is better to build whatever can be got for a reasonable cost than to add all these things and make the cost so high that it is out of reach of the tenant.

In discussing types, methods and materials of construction ought not to be omitted. The difference in first cost between good construction and poor construction is not great and is speedily amortized in reduction of repair bills.

It seems to be fairly certain that the Government will build only permanent houses. It is not at all certain that these will be sold to the occupants and it is very necessary that the construction should be sufficiently good to make a good security for a long-term mortgage or sinking fund. The better the construction, the smaller the depreciation and the better the security.

The difference in cost between a six-room frame house and one of brick, concrete or tile is at present prices less than 15 per cent. The price of the lot is the same in either case, so that the difference between a frame house costing $3000 and lot worth $600 and a brick house on same lot would be about $450 or 8 per cent. Assuming 5 per cent for interest, the triennial outside painting would more than repay interest in his extra investment. By setting a lower rate for depreciation and amortization, it is possible to rent such a house at as low a rate as a frame house of the same size.

The Bureau of Industrial Housing and Transportation of the Department of Labor, created for the purpose of providing living accommodations for workers at munition plants and other establishments having Government contracts, has adopted a series of standards for permanent construction that will be enforced as to all the housing to be provided under the $60,000,000 appropriation granted by Congress.

Nine principal types of houses for permanent construction have been adopted, as follows: Type 1, single-family house; type 2, two-family house; type 3, single-family house with rooms for lodgers or boarders; type 4, lodging house for men; type 5, hotel for men; type 6, lodging house for women; type 7, hotel for women; type 8, tenement house; type 9, boarding house.

All row or group houses are restricted to a depth of two rooms. No living quarters will be permitted in basements. Brick, terra cotta, stone or concrete will be preferred. Fireproof construction will not be required, but roofs are to be fire-resisting. (*The Iron Age*, May 16, 1918, p. 1270)

MANUFACTURING IN RELATION TO BANKING, RESEARCH AND MANAGEMENT

By WALTER RAUTENSTRAUCH, NEW YORK, N. Y.

Member of the Society

PERHAPS there has been no other time in the life of our nation during which the social and economic problems confronting us have been so vital, so perplexing, and of such colossal magnitude as those which confront us now. Nor have there been such times as these not only to test the strength of our material resources, but also to prove the good and the bad in the articulation and functioning of the elements of our business system through which our resources are created and distributed. Our engagement in this most gigantic of wars is serving not only to present new and more perplexing problems, but also to emphasize the needs and accelerate the demands for an entire reconstruction of our whole business and social relations. Not only are we compelled to bend every energy to carry to a successful issue a campaign for principles by which nations may live in harmony and peace, but circumstances demand that we also reconstruct the foundations upon which shall stand economic and social institutions capable of leadership in the new world which shall rise from the ashes of the old.

Under most unusual circumstances, therefore, are we required to seek solutions for difficulties which even in normal times would demand the keenest minds and the strongest characters to accomplish.

Many agencies, governmental, industrial, and corporate, are at work in an endeavor to adapt present facilities and create and operate new facilities for carrying on the business of war, and not only for war, but also for the many perplexing industrial, agricultural, and social situations incident to the problem of living, which the war has seriously disturbed. We have vast potential forces, which are matters of just pride, but we are thankful that we are conscious of our weaknesses and inexperience and that we recognize the difficulties and failures which surround us. The many heated debates in the councils of our leaders and criticisms in the daily papers on the conduct of governmental and industrial affairs make us more and more conscious of the need of a business system which is more fundamentally sound and the need of higher ideals upon which such a business system may successfully be founded. We have long held the reputation for wastefulness which abundance of resources creates. The quick acquisition of wealth without the moral strength of character which arises from the toil and sacrifice of production has raised up many leaders who predominate over the controlling forces of our civilization and tend to destroy right standards of service and create false standards of living. The reflection of these influences in the conduct of affairs has occasioned much waste in resources and effort and created many of these problems which confront us today.

But as we contemplate the many instances of waste in resources and effort which accompany our endeavor to carry this war to a successful issue, we find that the inherent nature of the conditions by which these wastes occur is no different than that which many of us have observed in normal times, only in a lesser degree. It would seem that our failures reside in these particulars:

1 Individualistic effort as opposed to coöperative effort

2 An undue regard for the might of "purchasing" power as opposed to the might of "creative power"

3 A lack of appreciation for science or the scientific spirit in the conduct of our business system.

The introduction of corrective measures which will enable us to counteract and reconstruct these tendencies reaches every field of human endeavor, and the very nature of the changes demanded positively indicates that this must needs be. We are dealing now with an attitude of mind, the creation of a philosophy, if you please, upon the foundations of which we hope to rear an economic and social machine which will withstand the onslaughts of a world catastrophe—indeed, by means of which such catastrophes may be made impossible.

In every movement or effort to betterment there are certain avenues of approach or mediums of operation through which most effective results can be accomplished, and as we review the problems before us and the particular institutions factoring therein, it seems that among these the manufacturing industries take a high place. Any right effort to place our wealth-creating agencies, as represented by the manufacturing interests, on a higher plane and in proper coördination with other controlling factors of our civilization will render a lasting service to mankind. A close analysis of the manufacturing problem will indicate that corrective measures must be applied both from within and without the immediate province of the enterprise. It will be our purpose to consider three particular avenues from which relief may come, and these are in:

1 The closer relation of our banking institutions to productive enterprises

2 The closer relation of our universities and educational institutions to the industries

3 A broader conception of responsibilities in the management of factories.

1 Relation of Banking to Productive Enterprises

For many years the economics of barter and trade have so engrossed the interest of capital that the opportunity of profits in dealing with what others have produced has overshadowed any interest in the economics of production and the obligations of capital toward it. Wealth distribution and acquisition therefore have become of primary importance in our industrial philosophy, while the wealth-creating agencies have been factored to only a limited degree. Only as necessity has forced the issue, and not as a matter of fundamental policy, have the wealth-producing agencies been raised to the plane of excellence which their value demands. This attitude of mind is well reflected in the usual methods employed by banking institutions in extending their credit facilities to those engaged in productive enterprises. Because of their obligations to their depositors, the banks have had to have regard for the quick assets of the borrower, so that the acceptance of all customers' notes is primarily conditioned on this particular.

Abstract of paper presented before the Philadelphia Section of The American Society of Mechanical Engineers, November 27, 1917, and before the New York Section, January 8, 1918.

Indeed, sound banking demands the customer's liquidation of obligations at stated periods, and for this reason the customer's possession of quick assets has been the deciding factor in credit extensions. When we realize that about 4 per cent of the daily business transactions of this country are conducted in money or currency and 96 per cent are recorded in open-account credits, checks, notes, and bills of exchange, and that a disturbance of this ratio, say a demand for 10 per cent cash settlement, will inaugurate a panic, we appreciate that emphasis in the matter of the borrower's quick reserves is well placed.

While the Federal Reserve Board is causing our banking institutions to have more regard for the borrower's ability to liquidate his banking obligations at maturity, its influence is

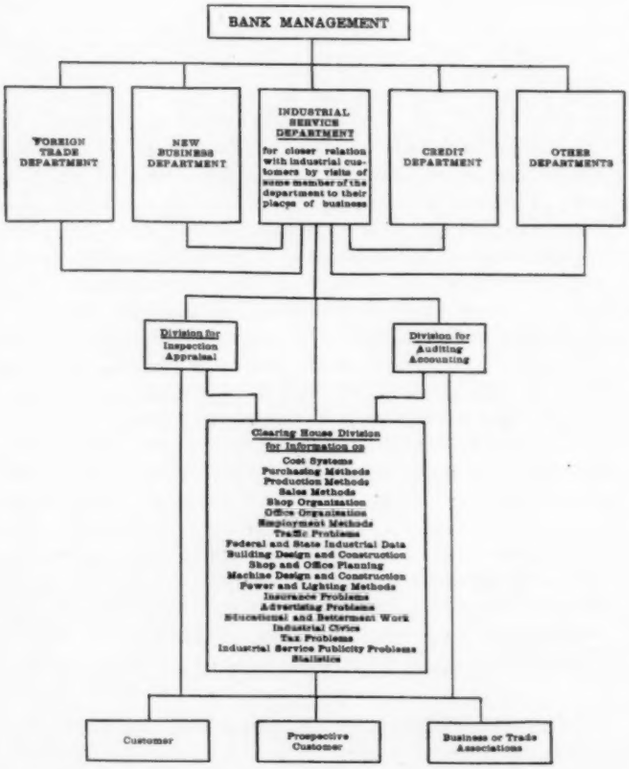

FIG. 1 ORGANIZATION OF INDUSTRIAL-SERVICE DEPARTMENT, NATIONAL CITY BANK OF NEW YORK

such as to point out that this ability does not alone rest in the possession of quick assets, but that it is also dependable on certain factors which condition the life and prosperity of the enterprise itself. Wealth-creating ability as represented in factors which every engineer understands is being appreciated, together with purchasing ability as represented in readily convertible assets. The inauguration of credit control through the medium of the Federal Reserve Banks, therefore, has not only served to promote a more sound banking policy in the matter of credit extensions, but it is also causing the more progressive bankers to view seriously the whole banking problem in relation to industrial enterprises. In other words, there is being created a larger sense of obligation and of opportunity to serve the industries that through the closer coöperation of the two both may grow into stronger institutions.

Not only has this influence been working in the relation of banks to manufacturing industry, but also in their relation to the agricultural interests. In this instance it is particularly true that the foundation of credit must rest on anticipations which are realized through sound business methods, and therefore the banks are compelled to interest themselves in this phase of the borrower's soundness.

Instances of coöperation between the bankers and the productive industries evidence an awakening to opportunity in which we may take great hope. Not only is there a recognition of a "more business-like application of credit" which rests upon the fundamental laws conditioning the prosperity of the wealth-creating industries, but there is also evidence of a real spirit of interest and helpfulness, in that there is maintained a personal and intimate contact through scientifically-trained bank representatives.

In the field of industrial banking we have also just reason to feel that an appreciation of the broader field of usefulness of banking facilities is being felt. Under wise leadership the National City Bank of New York has inaugurated an industrial-service department which it is believed will have a most helpful influence in the field of industrial development.

In establishing this new department of "Industrial Service," the bank hopes not only to increase the usefulness of its banking facilities to business by adding to its means of recognizing and crediting merit where credit is due, and thus to blaze the way for more constructive coöperation between banker and client, but also, by placing the emphasis on better methods of doing business, to help swell the tide of interest in scientific cost-keeping and more efficient management—regarded by keen observers as essential to our success in the worldwide economic struggle certain to follow the present war. The chief effort, therefore, of industrial service will be exerted along strictly coöperative and educational lines.

With the permission of Mr. Schwedtman, of the National City Bank, is presented herewith in diagrammatic form the embodiment of the new Industrial Service Department in the scheme of the bank's organization.

A study of this chart will show quite clearly the thorough manner in which the bank is prepared to be of specific help to the manufacturer in every field of technical and financial service. A new industrial philosophy is springing into being, and the spirit of intelligent helpfulness is guiding our endeavors to establish more firmly the foundations of our national welfare and growth.

2 THE RELATION OF OUR UNIVERSITIES AND EDUCATIONAL INSTITUTIONS TO THE INDUSTRIES

It is impossible to record the development of our manufacturing institutions without bearing testimony to the labors of the scientists whose investigations and researches have been the very cornerstone upon which the industries are founded. While this is so obviously true, its significance is not always realized, and there has accordingly developed in many quarters a departure of the industry from the help of the scientist and a failure of the scientist to coöperate with the industry. Consequently the scientific spirit or attitude of mind is lacking in many of our industrial institutions, and the engineering and scientific schools where the activities of the scientist are largely confined have not always embodied those methods of operation which make apparent their industrial usefulness.

The time has passed, if indeed it ever has been, when the industries and the engineering schools can come to their full possibilities without close coöperation. The separation of the two institutions, whose technical interests at least are one, has been a loss to both in spite of the rapid development of each. The men coming from our schools have not been as well

prepared for immediate usefulness as they might have been, and the industries have failed to profit by the results of scientific discoveries which have never become known beyond academic circles. In fact, one of the greatest services to be rendered by our engineering schools lies not so much in the discovery of new facts and principles as in the introduction in the industries of many scientific discoveries dormant in the archives of the scientist, the commercial possibilities of which have never been appreciated. The patient search for scientific laws and principles underlying industrial processes and economic relations by those skilled in methods of research, and, moreover, the careful and judicious application to an almost limitless field of human endeavor of the already established facts and laws which have never been put to effective use, together with the preparation of highly skilled engineers capable of making and supervising these applications, is a plane of usefulness to which our universities must rise that they may take their proper place in the development and growth of our nation. Here, also, the obligations of this development lie both within and without the academic walls.

While engineering is highly technical, it is essentially an economic study. Just as the banker operates through the medium of bonds and stocks and is successful as he understands the laws which condition their value, so the engineer operates through materials, machinery, and men, and is successful as he understands the laws which condition the existence and prosperity of manufacturing institutions. While the most direct effect of engineering education in the past has been its contribution to purely scientific facts and principles, to the exclusion from consideration of those conditions under which these may be commercially useful, the economic necessities of the industries demand that we modify both the content and the spirit of the subject-matter handled and more closely parallel the economic requirements of engineering practice. The tendency in our engineering schools today, therefore, while emphasizing the necessity of excellence in the treatment of scientific facts and methods of analysis, must be increasingly toward that commercial and economic treatment which is so essential to an adequate knowledge of the use of science in engineering service. We find, accordingly, that those subjects in engineering instruction which were formerly thought to have their sole foundation in the sciences of physics, chemistry, and mathematics, and which conveniently admitted of formulated treatment, must be modified in their presentation to the inclusion of questions of cost and the influences of economic environment. Though it was once believed that, because engineering practice required a knowledge of scientific facts and principles, instruction in these alone was a sufficient preparation for the practice of the profession, it is realized that this is not sufficient, and that a knowledge of the economic adaptability of facts and principles is of equal, if not of greater, importance to an adequate understanding of engineering practice.

Accordingly, while formerly a student was taught to manipulate with the mathematics of thermodynamics in explanation of the behavior of steam in an engine, instructed in the principles of performance of waterwheels through the sciences of hydraulics and mechanics, and shown how to compute the stresses in a framed structure through the principles of graphical statics, he must now be taught, in addition to these, that the cost at which power may be generated is determinable by clearly defined principles and laws by means of which he may decide whether a steam-power plant or oil-engine installation or water-power development, each with a given type of housing structure, is capable of producing power in this locality or that locality with minimum cost of investment, depreciation charges, and cost of labor and materials, and will operate to satisfy a real demand and justify its creation. He must learn not only how a machine pattern is made by some method selected for demonstration by the instructor, but also that it may be made in a variety of ways, each of which is justifiable according to the quantity of production, demand for rearrangement of parts, adaptability to economic methods of molding, and to other conditions affecting the cost of producing castings by it. Not only should he learn to determine the proportions of machine parts to suit the loads imposed upon them, but also that the proportions must be modified to permit the part to be duplicated in a series of sizes of a given class of machine, or to facilitate founding and machining operations, that the completed machine may be supplied to the market at a price and in competition with other manufacturers of the same class of goods.

These attempts of our engineering schools in the past to make the instruction in engineering subjects more nearly representative of standard practice have met with more or less success, depending on the closeness of contact of the instructors with engineering practice and their ability to incorporate the spirit of engineering in methods of instruction. The effect of a proper amalgamation of the purely scientific and technological aspects of engineering with the economic and commercial principles upon which successful practice is founded is to create in the student that sense of proportion and judgment which tends to economize his efforts in contributing to scientific progress and invention. Not only will he know how to proceed to judge the scientific feasibility of a project, but also to determine what commercial limitations make a scientifically possible project impracticable; and, moreover, if he has that rare spirit of inquiry developed by proper methods of instruction, he may be able to determine that commercial limitations in a given field of practice exist because of an insufficient or entire lack of knowledge of scientific facts and principles, and thus be led to an investigation of scientific foundations the successful issue of which may be a most important contribution to the revolution of engineering practice in a given field.

Perhaps the most striking instance of this latter kind of scientific investigation is that conducted by the late Dr. Fred W. Taylor. His studies in the ancient art of cutting metals and the discoveries resulting therefrom have not only caused the redesign of nearly all of our metal-cutting machines to the improvement of their functional characteristics, but have completely revolutionized the methods of machine-shop management, the influence of which is felt in many quarters not at all concerned with engineering processes.

But this attitude of mind necessary to a proper conduct of an educational campaign for industrial betterment cannot develop without the coöperation of the industries themselves. We may inquire, therefore, into the nature of this coöperation demanded and the ways in which it may be accomplished.

For many years we have been accustomed to look upon the work of the Department of Agriculture as rational and necessary to the development of our agricultural resources. Through the operations of its agricultural experiment stations in every state in the Union, its scientific laboratories and the work of its trained investigators at Washington, and more recently through its trained agricultural agents in every district of the nation, the department has been of invaluable help in promoting the most efficient methods of crop and livestock production.

When we seek for the same evidence of coöperation between science and industry in the manufacturing field, we find that no organization of this sort is to be found. There is, of course, good evidence of individualistic effort in many quarters, both in research and in the promotion of better methods of production, yet there does not exist the coöperative effort which the importance and value of the industries demand.

It may safely be estimated that the capital invested in manufactures is perhaps $25,000,000,000, and the annual value of manufactured products of all sorts nearly $30,000,000,000. Approximately 8,000,000 people are employed in the strictly manufacturing industries, and the value added through their labors is nearly $12,000,000,000.

Surely the economic importance of our manufacturing interests, as above reviewed, indicates a real demand for organized scientific effort to conserve and develop to its fullest possibilities this strong right arm of the nation.

Those industries which could afford industrial research laboratories have demonstrated their value beyond doubt. The wonderful laboratories of the General Electric Company, the Eastman Kodak Company, and others with abundant means, are counted among the big assets of the organization, since they have materially contributed to the strength of these institutions.

It is in such times as these, when all industries, both great and small, are depended upon for the creation of those products which our recently established $19,000,000,000 credit hopes to purchase, that we realize the need of helping those who surely need the assistance of industrial-development laboratories but cannot afford the investment or maintenance charges. In this connection it is extremely interesting to note the following paragraph from a recent issue of a New York newspaper:

"COÖPERATION IN RESEARCH

"British Way of Bringing About Progress in Industries

"Realizing that many industrial firms are barred from the benefits of scientific research into their particular lines of activity by the great cost, reports Consul Franklin D. Hale, Huddersfield, England, the Committee of the Privy Council for Scientific and Industrial Research proposes the introduction of the coöperative idea. In this way a firm that is unable to bear the entire expense of research could contribute to the cost and share in the benefits accruing to an industry as a whole. It is planned to establish trade research associations in England, to be formed as needed for each industry or group of industries, and aided by certain funds which the committee has in charge. One association is about to be organized for the cotton industry, and others will be formed as soon as possible for the wool, flax, oil, and photographic industries.

"The work that has already been accomplished through the committee's efforts, according to Mr. Hale, includes the discovery of three kinds of optical glass, the investigation of light alloys for use in aircraft, and the production of a new hard porcelain from purely British raw material. Researches into the recovery of tin are expected to save that industry a very large amount each year."—*New York Times.*

All phases of this subject cannot be considered, but it is sufficient to point out that the particulars of this need for industrial betterment seem to reside in the creation of industrial-research facilities and in the training of men through whom research may be conducted and introduced in the industries. In the last analysis the successful issue of this project must rest primarily upon the training of men, for not only must better production methods be discovered for particular industries, but there must also be those who shall actually introduce and operate them. Quite clearly, therefore, does there seem to be an obligation resting on the universities and the industries which can only be accomplished on a high plane of coöperation.

In what form shall this coöperation exist, and what shall be the specific means through which it shall become effective?

Of the several possibilities which suggest themselves, it seems that most fruitful results will follow from the establishment at our universities located in industrial centers of industrial development laboratories, to which all industries, both great and small, may have an equal access. The endowment of these laboratories that they may be independent of any income from specific industrial interests is absolutely essential to their free development and operation. With the establishment of such facilities there can be little doubt but that the great potential energies of our universities can be made directly available to the improvement of industrial processes. Not only will this be of benefit to the industries, but it also will react favorably to the universities and stimulate productive scholarship and scientific research which will be felt in every field of human endeavor. It is believed that these laboratories will soon demonstrate their usefulness in the manufacture of every commodity, and, although their introduction into the university organization must be gradual, it will not be long before the demands of the industries will require an equipment and organization which will compare favorably with that now possessed by the agricultural interests. A conception of what these laboratories may be, may be obtained from the illustration published in THE JOURNAL, June 1917, p. 547.

Together with the investigation of the technical problems of the industries, these laboratories must also fully consider the methods of organization and management by means of which the results of industrial research may be effectively employed in the industries. Therefore it is believed that such a project as this should also serve to promote better methods of management through which industrial-process development may most effectively be realized.

3 BROADER CONCEPTION OF RESPONSIBILITY IN FACTORY MANAGEMENT

So much has been written on the problems of production, both in regard to their general aspects and in relation to their specific solutions in particular cases, that it seems as if enough had already been disclosed upon the basis of which successful procedure in particular industries might be formulated.

For the past twenty-five years there have been accumulated volumes relating to details of facts, methods of analysis, and routine organization plans for the effective conduct of tool rooms, stock rooms, planning departments, general offices, specific production departments, and for the efficient use of men and machines. There is scarcely an industry about which literature of the above sort cannot be found. Unfortunately, however, we are so constituted that the creation of this literature is not alone sufficient to stimulate improvements in methods of production. In spite of the fact that information on methods of scientific cost-keeping can be had almost for the asking, the Federal Trade Commission has reported that only 10 per cent of our industrial establishments have a cost system worthy of the name. This lack of cost information is indicative of inefficiencies in processing and management which can be effectively controlled only through a knowledge of cost factors. Thus it appears that there is real need for an educational campaign which shall seek to establish as a basic prin-

ciple in American industries those methods and policies which have been so successfully tried in particular cases. And this campaign must be waged among those who are in positions of authority, who exercise the managerial function and are responsible for the policies which govern the business over which they preside. Engineers discuss these things among themselves, and institutions presided over by engineers benefit by these discussions, but there is not that freedom of association between engineers and financial interests which dictate policies to create a scientific attitude of mind in the management of affairs. While the engineer is in some measure responsible for this condition, nevertheless it seems that ownership interests must evidence a real desire for the acquisition of the engineering point of view before much real assistance can be rendered. Crises such as the present have broken down many forms of control based on inadequate knowledge of affairs to be controlled, and thus the value of the engineering aspect of industrial organization and control is being more adequately recognized. It seems, therefore, that one of the principal problems of the managerial function is to determine the basic prime variables of the industry it proposes to control and establish means by which these may be quickly and conveniently recorded and analyzed.

Under such methods the management will not be required to call in a department head and ask for a statement of affairs. This immediately makes known to the department head that the manager does not know what is really being accomplished, and his influence is accordingly lessened. If, however, these affairs are known to the management through adequate records, it will be possible for the management to call in any particular department head and tell him that his department is *not going to show results if present conditions continue*, why it is not, and what particular things must be remedied to obtain better results and how it may be done. There is nothing so helpful to the keeping of all divisions of manufacture up to a high state of perfection as the feeling that the management really knows what is going on and can be of real help when assistance is required. When the management adopts the attitude of real helpfulness and looks upon itself as the chief servant of the industry, then we will have made a great advance toward a more adequate control of enterprises. It is the duty of the management to foresee and prevent difficulties arising, and this can only be accomplished by the establishment of adequate channels of information on the factors which condition the success of the enterprise.

It has been the experience of many to learn of well-conceived schemes of plant management falling away from the plane of perfection on which they have been established and thus discrediting the value of scientific-management principles. This again seems to indicate the need of an educational campaign among those who are to be depended upon to operate and keep in adjustment the new machine by which manufacture is to be controlled. No one would expect a delicately adjusted machine to operate well in the hands of an unskilled mechanic, yet many highly developed plans of management have been expected to continue in good operation in the hands of unsympathetic and poorly informed foremen. It seems that those who are capable of conceiving the broader principles of management and devising means for their embodiment in industries have gone too far beyond the capacity of those who are supposed to coöperate understandingly. In any improvement in management methods there must accordingly be promulgated a sympathy and understanding on the part of those affected thereby. It is dangerous to proceed in improvements beyond this point, for the plant will soon drop back to the level of understanding of the force and the investment will be lost.

Employers must surely take an interest in the education of their men, for no progress can be made beyond the general plane of intelligence of the shop.

This can be accomplished through coöperation with trade schools, correspondence schools, and the industrial departments of the Y. M. C. A. No matter how excellently the scheme of management and the methods of operation may be devised, no permanent progress will be made nor results attained if the vitalizing influence is lacking. This sort of problem cannot be solved in terms of x and y, and its importance is great in proportion to its difficulty of formulation. It is the thing which holds men together and creates in them a real desire to coöperate. It prevents men from taking a secret pride in the downfall or failure of others. It makes each department head feel that he is there to serve every other department, and his success is measured in terms of real service and helpfulness. An organization without this spirit is dead and will never hold together for a long period of time. While, therefore, it is incumbent on the management to see that the best methods of operation are devised and the most reliable means of control are established, it is believed that these will never accomplish the desired result without a proper selection of personnel through which the real life of the organization may be maintained.

It is beyond the province of this discussion to consider the details involved in the formulation of methods of procedure by means of which these problems of management may be solved in any industry, for, while each kind of industry presents the same general management problems, the means employed for their solution are very often quite different, because of the nature of the commodity dealt with and local conditions to be encountered, and therefore these details are not particularly helpful. We wish rather to realize that there is lacking in American industrial life that conception of the management function which is the foundation upon which all successful methods of factory operation must rest. When the engineer is more intimately associated with our financial interests and the university is more closely identified with productive enterprises, it is believed that the resulting amalgamation will effect a change in attitude toward the problems of management which will inaugurate the creative measures necessary. It seems there must be a closer coöperation of all interests factoring in industrial development in order that a true perspective may be had of the scientific, financial and human elements of the management problem. It is believed that this must be effected by a campaign of education which shall include the man at the bench as well as those who control his environment.

A paper on the problem of labor turnover and its cost, which was read at a recent meeting of the executives of the Albaugh-Dover Company, of Chicago, and which is quoted at length by M. C. Hobart in the May 16, 1918, issue of *Power*, includes the following estimate of the cost of placing a new man at work:

For advertising	$0.50
For hiring and clerical work	0.75
For instruction	5.50
For wear and tear on machinery and tools	12.00
For loss of production	25.50
For spoiled work and mistakes	12.00
For accidents	3.00
For interest on extra equipment	0.50
	$59.75

MAN POWER: ADDRESS AT MEETING OF BOSTON SECTION

By J. PARKE CHANNING

Chairman of the Engineering Council

A SUBJECT of the greatest importance and of most serious consequence to the American nation at the present time—man power—was discussed at some length in an address delivered by J. Parke Channing before the Boston Section of the Society on the evening of March 16, 1918. Most favorable comment was elicited by this address, which is here given in abstract form:

We are probably accustomed to think that we are efficient in the United States, particularly when it comes to such things as mining and manufacturing. The conduct of the war has demanded in England and in France a complete readjustment of manufacturing methods and plans and today England is probably as efficient a country as there is in the world, not even excepting Germany. England is in a position in which practically everyone in the country is engaged in some industry necessary for the conduct of the war, and this has been accompanied by an increase in the efficiency of her tools and the efficiency of her man power.

In the United States we certainly have been efficient as far as machines and perhaps as far as methods have been concerned, but we have not been efficient in the utilization of our man power. The problem that confronts us today and will all the more confront us after the war, is to make our man power efficient. There is one thing in England that has permitted her to reach this condition of state socialism with comparative rapidity, and that is that practically all of her laborers are English. While an Englishman may be a strong union man and ready to fight his employer tooth and nail, still at heart he is a British subject, and when his country was in danger he rose to the occasion.

In the United States we have such an admixture of unassimilated foreigners that the problem is more difficult, and so far we have not been brought to the point of stress which has arrived in England. But if we are to carry the war to a successful conclusion and if we are to increase our efficiency after the war we must introduce methods which will Americanize these foreigners and give them our own point of view.

I wonder if any large number of you have read the so-called proposed reconstruction program of the British labor party. This program will of course be subject to a great many modifications before it is adopted by the party. It is very largely socialistic and has for its basis four principles, namely:

1 The universal enforcement of the national minimum
2 The democratic control of industry
3 The revolution in national finance
4 Use of surplus wealth for the common good.

If these four demands are carried out, then surely England will be a socialistic state. I am not prepared to say how much of this program can or will be carried out, but it shows the trend of thought of the laboring man in England. He realizes that when the war is over, unless the greatest care is used in the reorganization of the regular industries there will be an immense amount of unemployment, and that this, if unchecked or uncared for, will result in an oversupply of labor and, if the old standard is maintained, a corresponding diminution in wages. Hence his insistence of the first principle of a minimum wage.

In demanding democratic control of industry he has seen such good results obtained in war work that he sees no reason why this control of industry should not be just as efficient in after-war conditions.

In the third principle, the revolution in national finance, he demands that taxation shall be so adjusted that it will yield the necessary revenue to the government without encroaching upon the prescribed national minimum standard of life of any family whatsoever, without hampering production or discouraging any useful personal effort, and with the nearest approximation to equality of sacrifice.

The fourth principle of the English laborites is that the surplus wealth shall be used for the common good. They say we have allowed the riches of our mines, the rental value of the land superior to the margin of cultivation, the extra profits of the fortunate capitalists, and even the material outcome of scientific discoveries, to be absorbed by individual profiteers, and they demand that in the future a large proportion of this surplus shall be applied to the common good.

It is not for me, nor am I a sufficient student of economics, to pass upon this program. It has certain merits and I am only calling it to your attention so that you may see that just this same thing is liable to come up in the United States. And the trouble will be that the pendulum will very likely swing too far if the employer class in the United States does not give more attention to the laborer and see that his condition is improved. You, as engineers, are in the position to act as instruments for carrying out this necessary work. Whether it be in a mine or in a manufacturing plant, I believe I can say that today a large proportion of the managers and executives are engineers.

The question to bring clearly before us is, are we properly trained to bring about this improvement in our social condition to improve the living conditions of our laborers and at the same time to improve their efficiency? I fear that a great many of us are not. We may be good technical men but we are not sociologists nor psychologists. We understand production of kilowatt-hours from coal or from water power, we understand the machine by which it is utilized, but we do not understand the machine which produces our man power.

This week I attended a conference at Columbia University in which the question of giving the engineering students a course in human engineering was discussed, and I came away with the idea that the authorities were beginning to realize that this was of paramount importance and that this training must be given the engineering student before he can be turned out as a man capable of eventually holding a high executive position. In my opinion there never was a time when it was so necessary to impress upon engineers and engineering students the importance of this human side of engineering.

I wonder how many of you can tell me what trade unionism is—you men who have had to deal with unions and who have had strikes. The fact is that none of you can tell what trade unionism is, because trade unionism is not an entity but a term of broad generalization covering a great many distinct aspects of the labor problem. A few weeks ago I presume I would have been rash enough to have attempted to give a definition, but in the meantime I have read Professor Hoxie's work on Trade Unionism in the United States and my ideas on the subject have been much clarified. On reading it you would find

that trade unionism can be classified under two broad general heads, one giving structural varieties and one functional varieties. There are four divisions in each class and any one of the structural varieties may function in any one of four different ways. There is one basic and most important thing which you would realize, an ever-present fact, and that is, that the interest of the laborer and the interest of the employer are diametrically opposed, just as the interest of the buyer and the interest of the seller are opposed, and that from the very nature of things they can never be identical and that all that can ever be reached is a compromise. And who is better qualified to bring about this compromise than the well-trained engineering manager, who, with his broad knowledge and experience of both capitalist and laborer, is enabled to act as an arbiter or a judge and arrive at a decision at least fairly equitable? It is the engineers of this country who are in a position to solve the labor problem, or at least to produce a solution as nearly ideal as possible.

The claim is made in Washington that it is difficult to get executives for war work, particularly executives who understand the handling of man power. I am told that some of the new plants for war industries have been most carefully laid out, taking into consideration the routes by which material is to arrive at the plant, its progress through the plant and its method of removal, the supply of water, coal and other material, but in a great many cases no thought has been given to the handling of the men or to their housing. These have been left to a hit-or-miss adjustment after the plant was up.

In 1916, under the auspices of the Y. M. C. A., the first convention to discuss the human side of engineering was held in Ohio. They lay great stress upon the advantages which would accrue to engineering students if they had an insight into the mental operations of the laboring man, and this had been fostered by getting the engineering students to volunteer one or more hours in the week for instruction to laborers employed in adjacent plants. This instruction is either in the English language, in citizenship or in athletics. A man who has volunteered for this work and who has done it for a year or more, when he goes out into active life is a much more capable foreman than one who goes out from an engineering school and meets his first laborer on the job. Lately the National Americanization Committee of New York has been conducting a similar propaganda, sending to the various educational institutions of the country a proposed basis of a course on industrial engineering. This proposed course goes into the scope of industrial engineering, describes the problem and the field, and takes up the question of the engineering insight of the work in reference to plant building, its location, and the fundamental considerations in its construction; it also takes up the management and division of the work, the analysis of the costs, the machinery, the materials and the efficiency methods. It goes into the questions of employment, management, and the methods for hiring, promoting and transferring men. It also takes up industrial welfare, with the various incentives to the workman and the provisions for his health and recreation and for the vocational training of either himself or his children. It also gives him instruction in conditions outside of the plant—the housing of the men and the planning of the town, and the health and recreation and education of their families. It takes up the problem of Americanization and what shall be done to make our melting pot efficient with no dross, and finally it gives him instruction as to what has been done and what should be done in legislation.

You engineers who are college graduates should use your influence to see that courses in human engineering are introduced in your Alma Maters, if they are not already there.

CORRESPONDENCE

CONTRIBUTIONS to the Correspondence Departments of The Journal by members of The American Society of Mechanical Engineers are solicited by the Publication Committee. Contributions particularly welcomed are suggestions on Society Affairs, discussions of papers published in The Journal, or brief articles of current interest to mechanical engineers.

Aircraft Production

TO THE EDITOR:

The trend of the criticism of our aircraft production lays great stress on our failure to turn out machines, and particularly the delay in the production of the Liberty motors.

Men who have been through the mill of organizing new industries, or making changes in the personnel or the product of an industry, know that the element of time is one for which there is no equivalent. Unlimited capital cannot quickly produce one of the most highly developed and intricate machines of the present time.

The airplane as a whole stands preëminent as one in which every element of design, workmanship and material must be the best; in fact, the present contest in the air is one that makes a supreme test and can only be satisfied by a supreme effort of each one of the designers, managers and skilled workers on the production side, combined with the ablest military aeronautical direction and skill.

We all recognize the importance of specialization for both the individual and the industrial plant, but we sometimes fail to give this matter sufficient weight in dealing with industrial problems.

We frequently make changes in the personnel or product of a plant without calculating the handicapping effect of such changes. Changes in either personnel or product must be warranted by very important demands. The degree of handicap of such changes is measured by the degree of special ability or skill that is required in the production of the product.

The airplane engine stands at the highest point that has been reached by man in his production of a machine in which each of the elements is subjected to the highest possible stresses. This approach to perfection can only be attained by the highest degree of special ability and skill; hence, the delay in production. This applies to the refinements of the design as well as precision of workmanship.

If many blunders have not been made in reaching the present stage of development, then our achievement at the present time will go into history unparalleled. We have had available the best men in each field of endeavor, but since this is a new art ninety per cent of these men have had no previous experience in this line of work.

The recent change in which the highest executive ability has been made head of the entire production plan is in keeping with the fundamental need of the aircraft-production plan. It gives it that stabilization in which alone stands our hope for success. It will prevent the disturbance of that natural evolution of the industrial plant that takes place when there is the minimum shifting in personnel and product.

This is particularly well known to industrialists, but difficult to explain to an investigating committee. The industrialist knows that the best way to obtain results under present circumstances is what we may call the natural way. The natural way makes the minimum change in the personnel and the working methods of each individual. It uses men as they are found in the organization.

A new industry always goes through two phases that are seldom fully anticipated. The first one, in which the aircraft industry is at present, is one that brings most serious disappointment. The second one, which is ahead of us, brings a happy surprise. Both are due to the same fundamental element and cannot be wholly forecast.

Experience tells us that it takes a great deal longer time to get a new industry established than is expected. This is due to the fact that industrial life rests on the functioning of the individual and the coördination of all the men in the organization, and although this is a fact borne out by many examples, yet the average board of directors in an industry is disposed to make important changes in the personnel of its executives, and this in turn frequently results in changes throughout the entire plant; and it is at this point that we must not blunder at the present time. No greater menace to our success in this war stands facing us than the mere possibility of our disturbance of the natural evolution that is going on in the aircraft industries.

This natural evolution will bring about the skilful operation of each worker at his task and the natural coördination of all forces.

The tendency to put in impractical inspectors carrying out impractical specifications must be scrutinized with greatest care. Important changes in the executives should be made in the direction of practical men rather than talkers.

Regarding the difficulty of getting under way, we have many examples. We have seen mammoth buildings erected in incredibly short time. We have seen these buildings fill with the best machinery and with the best men of the country as executives and workers. In the early stages of the development, as we observed the spectacular advance of getting together so much material, we failed to realize the full significance of the meaning of coördination, and we have overlooked the fact that a "going" industry is the result of continuity of action on the part of each worker and manager.

Unfortunately, examples of this kind do not leave a permanent impression. We accept the facts when stated to us, and then as a people we go ahead and make the same blunder over again.

In the aircraft work I am confident that no such blunder is impending. The purpose of this, however, is not only to pay tribute to those who have been working effectively in this great program, but also to spread the gospel of stability of organization, the value of specialization, and the ultimate supremacy that will come to us if we will only follow along the lines that have been well established by our greatest industrial successes in this country.

Financiers have reached the point where they pin their faith on stable organizations. They know that success grows out of specialization, which carries with it standardization and stability of personnel, and they know that where there is continuously change of management or the "hire and fire" plan in the plant, or perpetual altering of the design of the product of the plant or the character of the work in the plant, these elements interfere both with the character of the workmanship and its profit making. They know that great successes are wrought by men who keep in mind this simple fact.

The highest and best production will be attained by each one considering it his patriotic duty to aid those under and over by the heartiest coöperation, for it is only by coöperation in the right spirit that we can hope to equal in organization an organization that is built up under a despotic government.

We are rich in resources of skilful workers, in material, and in highly efficient machinery, but our ultimate supremacy is facing a terrible menace in the tendency to make a change in management that will disturb the executives or workers in the acquisition of ability and skill in their new duties and tasks and will delay the coördination that is the foundation of an industrial organization.

To bring this matter closer to a concrete example, close observers of industrial economies know that in the machine-building industry it is practically impossible to design and quickly construct a satisfactory machine. They know that each new machine can only reach a satisfactory stage after it has been made in numbers and through a period in which each of the workers will have had an opportunity to work up a precision of operation and skill in the performance of each of the tasks.

This makes it impossible to make a successful machine in a short period, even if all the workers of the plant were available. This fact, that repetition of operations is essential, is the key to the whole situation; and they know that the condition in an industrial organization in which the work flows quickly through the plant without congestion at any one point is brought about by experience. It is aided by practical supervision and handicapped by impractical interference.

It is our work to emphasize the simple every-day rules of common sense on which have been based our greatest industrial successes.

We must recognize that Germany's success in the industrial world, previous to the war, and her present industrial strength are due to the fact that by nature and government continuity of action of the individual was the rule instead of the exception. During the thirty years of industrial progress of Germany there was an increasing trend toward specialization. We know, too, that it was specialization that gave America the leading place in the industries.

Growing out of our specialization there came into existence those who became specialists in industrial management. These men are of the greatest possible value to the Government if they are forced to bend their systems to fit natural law.

Our ablest young men have gone into this profession and have been rendering a distinct service, but their work must be coördinated with the natural flow of work from man to man that can only be discovered by experience in each industry.

It seems paradoxical that our best minds, our most patriotic citizens, those who have the highest esteem for man's independence and liberty, may in this critical hour, by methods that are scientific as far as they go, actually produce a result opposite to that for which they are working.

In times of peace a monkey wrench thrown into the gears of one machine in an industry, or a false scheme of management into one industry in the country, was not such a serious matter as it is today. Today this country is being transformed into one big industry for producing war machinery, and finds

itself associated with the Allies in a contest that is too difficult to risk any one element in our plan, and it is absolutely necessary to have a definite policy on this kind of management in order to prevent duplication of certain blunders that have been made in recent years.

Our successful industries have grown by natural processes and management that understood human nature. Some have had the benefit of the modern school of industrial management, and some have been seriously handicapped by it.

In this war program we should take no unnecessary chances, and from now on we should see to it that the plan of action should tend toward continuity of service for each worker in order to get that natural coördination that is necessary to accomplish results.

As for the ultimate outcome, we can confidently depend on results that will even transcend the statements that have been made by the optimistic who overstated the possibility of the early stages of the work. Each succeeding year will see America coming in with greater and greater force. This will be true if we adopt a plan that allows a reasonable continuity of action; but we will rise to our highest supremacy through our resources in man and machinery if we will follow the plan of greatest stability in personnel and product that has been demonstrated in our most successful industries.

JAMES HARTNESS.

Springfield, Vt.

The National Sections Should Always Coöperate with Local Societies

TO THE EDITOR:

In comment on the paper by Mr. Louis C. Marburg on the new By-Laws governing the Sections of the A.S.M.E., recently published in THE JOURNAL, it may be worth while to emphasize further the idea that the development of the local sections of the national societies should by no means be permitted to interfere with the growth and development of the local engineering societies in various cities. All the national societies are now encouraging the building up of local sections or chapters, and it is universally agreed now that this forms the best means by which the national societies can be truly national and can avoid concentrating all their activities at their New York headquarters. If, however, it is attempted to maintain in any city of moderate size separate, independent local organizations of civil, mechanical, mining and electrical engineers, each meeting entirely independently with separate headquarters and staffs, the result would inevitably detract greatly from the strength of the local society.

Practically every one who has given careful study to the question agrees, I think, that in the building up and strengthening of the local engineering societies all over the country lies the best hope of strengthening existing organizations of engineers. In many cities, St. Louis and Philadelphia, for example, the problem was long ago successfully solved of establishing full coöperation between the local sections of the national societies and the strong, well-organized local engineers' clubs. Under such a coöperative plan, the different organizations are mutually helpful instead of competitive. Mr. Marburg clearly states the reasons why coöperation is helpful and necessary, and the committee of which he is a member has shown wisdom in so plainly recognizing the situation and providing for it in framing their By-Laws for the conduct of the A.S.M.E. Sections.

CHARLES WHITING BAKER.

New York, N. Y.

The New Local Sections By-Laws

TO THE EDITOR:

The address by Louis C. Marburg on the new Local Sections By-Laws of the Society which appears in the March issue of THE JOURNAL is to my mind one of the most important papers which has appeared in its pages for a long time. It points out the fact that our Society is for the benefit of the engineer, no matter whether he is located in New York City or in some remote part of the country.

The new By-Laws make our Society a truly democratic organization, and the members of every Section throughout the country should take advantage of the opportunities thus given them to strengthen the standing of the profession in their community and thereby also benefit the parent body.

In these strenuous times the busy engineer has little time for reading, and I fear that Mr. Marburg's address will not receive anywhere near the publicity it deserves. I wish there was some way in which it could be brought to the attention of every member of our Society, and I would like to suggest that the Committee on Local Sections urge each Section to have a meeting in the near future where this address will be made a special feature and given more than the usual amount of publicity. To add to the interest of the meeting, I would suggest that a member of the Council be requested to present the address to the Section, instead of having it read by one of the local members. If something of this sort could be done, and this very important matter brought to the attention of the majority of our members, I believe the Increase of Membership Committee would find that there was no further use for its activities. Such a step would put our Society in such a position that there would be no question in the mind of any engineer as to which engineering society was the strongest and most influential. The only question would be which society stood next to the A.S.M.E. in the good it is doing to our country and to the profession in general.

I want to congratulate the Committee on Local Sections and the Council on the splendid work that they have done in the way of broadening the influence of our Society.

I. E. MOULTROP.

Boston, Mass.

The Second Law of Thermodynamics

TO THE EDITOR:

As expressed by Clausius[1] and Lord Kelvin,[2] the second law of thermodynamics has been generally understood to mean that work may not be obtained from the inherent heat of the atmosphere.

Although these statements apparently have been mathematically demonstrated, the mind nevertheless rebels against a law which denies the possibility of using any portion of the thousands of millions of horsepower existing at all times in the atmosphere. Such mental rebellion led the writer to attempt the utilization of this energy in spite of what is declared to be the second law of thermodynamics.

The result of this effort, which thus far has been imaginative rather than through mathematical treatment, seems to indicate several methods by which work may be realized from the heat in the air.

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[1] "Heat cannot of itself pass from a colder to a hotter body."
—CLAUSIUS.

[2] "It is impossible, by means of inanimate material agency, to derive mechanical effect from any portion of matter by cooling it below the temperature of the coldest of surrounding objects."—KELVIN.

A simple apparatus which demonstrates the fact has been constructed and operated by the writer and will be understood by referring to Fig. 1. This apparatus consists of but three essential elements, viz., the boiler 1, the turbine 2, and the condenser 3. A pipe connects the top of the boiler to the nozzle of the turbine and the casing of the turbine opens directly into the condenser. The condenser is provided with means for evaporating water from its outer surface. In the sketch this is shown as a fibrous covering 4, which keeps moist by drawing water from the receptacle 5 by its capillarity. A pipe connects the bottom of the condenser to the bottom of the boiler.

The operation will be most easily understood by assuming the plant completed and ready for starting. The first act is to exhaust the air from the entire system through the valve in the boiler. A quantity of liquefied gas sufficient to partly fill the boiler is next introduced through the same valve, which is

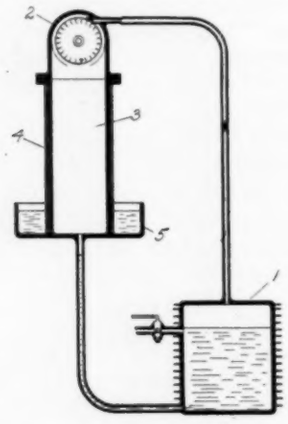


FIG. 1 APPARATUS FOR OBTAINING MECHANICAL WORK FROM THE HEAT IN THE AIR

then closed. Finally the receptacle at the bottom of the condenser is filled with water.

The heat interchanges or cycles, of which there are two, commence as soon as evaporation of water takes place from the exterior of the condenser. The water, in the act of evaporating, removes an increment of heat from the condenser, causing a reduction in temperature and consequently a condensation of the vapor therein. This, in turn, brings about a difference in pressure between the condenser and the boiler which is available for operating the turbine. The condensate from the condenser enters the boiler at a temperature lower than that of the atmosphere, which enables the boiler to absorb an amount of heat from the atmosphere equivalent to the amount rejected by the condenser to the atmosphere less the amount converted into work. The difference of level between the liquid below the condenser and that in the boiler serves in place of a pump for feeding the boiler.

The little plant shown in Fig. 1 has been running continuously for some time, using sulphur dioxide as the working fluid. It will be seen that the capacity of the plant is a function of the relative humidity of the atmosphere, being greater in a dry climate than in one of more humid character. Operation would cease when the relative humidity reached 100 per cent, or when the temperature fell to 32 deg. fahr.

That the mechanism operates at all is due to the fact that nature, in the course of her unending processes, is continuously depositing moisture out of the air, rendering it again capable of absorption in the manner and with the result described. If we were compelled to remove the moisture content, no doubt the work cost would balance the work derived, but if nature does this work without cost to us, it would seem that, as far as our interests are concerned, mechanical work may actually be derived from the heat in the air. Furthermore, it appears that under these conditions and through the agency of evaporating water, heat does in fact pass from a cold body to a hotter medium, for the heat from the cold condenser is rejected to a hotter atmosphere.

If these conclusions are correct—and they must be, since the machine runs—then the statements of Clausius and Kelvin are not strictly true.

The efficiency of the cycle, based on the standard of Carnot, is low, but it may even be that the Carnot cycle itself is not the final word in heat efficiency.

The question as to commercial possibilities has been asked, and after a careful study of the matter the writer is convinced that no commercially successful results may be hoped for, although remarkable performances might be realized if no attention were paid to investment costs. The heat interchanges may be of interest to other members of the Society as they have been to me.

PERRY OKEY.

Columbus, Ohio.

REVISION OF BOILER CODE

THE Council of the Society directed that a hearing be conducted in accordance with the recommendation in the Boiler Code that a meeting at which all interested parties may be heard be held at least once in two years to make such revisions as may be found desirable in the Code, and to modify the Code as the state of the art advances. The first of these meetings was held at the Society's headquarters in New York, December 8 and 9, 1916.

The Council also directed that the proposed revisions in the Boiler Code be published in THE JOURNAL, with the request that they be fully and freely discussed, so as to make it possible for any one to suggest changes before the Rules are brought to the final form and presented to the Council for approval. This has been done, and the revisions were presented in the March issue of THE JOURNAL, pp. 234-247, in the April issue, p. 316, and in the May issue, pp. 398-400, in the form proposed for submission to the Council, except as they may be modified by editing without change of sense.

The revisions finally agreed on are those that have been published in the March, April and May issues of THE JOURNAL, with the modifications which follow. Although these modifications are in a sense final, the Committee would like any one who has an important criticism or suggestion to offer to submit the same immediately to Mr. C. W. Obert, Secretary of the Boiler Code Committee, 29 West 39th Street, New York, N. Y.

MARCH JOURNAL, P. 235

PAR. 9:

IN THE THIRD LINE OF THE ADDED SENTENCE IN PAR. 9 AFTER THE WORD "IN." CHANGE "AND" TO "PROVIDED," AND IN

THE FOURTH LINE REPLACE THE WORDS "SHALL BE" BY "IS."

PAR. 19:

IN THE FIRST LINE OF PAR. 19 AFTER THE WORD "STRAPS" INSERT THE WORDS "FOR DOUBLE STRAP JOINTS."

MARCH JOURNAL, P. 236

PAR. 167:

AFTER THE WORD "DIAMETER" IN THE SECOND LINE OF PAR. 167*a* INSERT THE FOLLOWING:

Having a thickness less than 10 per cent of the outside diameter, provided the thickness does not exceed No. 6 B. W. G.

CHANGE THE LAST SENTENCE OF THIS PARAGRAPH TO READ AS FOLLOWS:

For other tubes the flange test is not required:

BOILER CODE, PAGE 41

PAR. 168. CHANGE THE FIRST SENTENCE OF PAR. 168 TO READ AS FOLLOWS:

168 *Flattening Tests.* A test specimen 3 in. in length shall stand flattening between two parallel plates until the distance between the plates is not over five times the wall thickness, without showing cracks or flaws.

MARCH JOURNAL, P. 236

PAR. 169:

IN THE LAST PART OF THE LAST SENTENCE OF PAR. 169 REPLACE THE WORDS "THE BLOW TO BE EQUIVALENT TO 2 LB. FALLING 2 FT." BY THE WORDS "OR THE EQUIVALENT."

BOILER CODE, PAGE 41

PAR. 171. CHANGE PAR. 171 OF THE BOILER CODE TO READ AS FOLLOWS:

171 *Number of Tests.* One of each of the physical tests specified shall be made from each of two tubes in each lot of 250 or less. Each tube shall be subjected to the hydrostatic test.

MARCH JOURNAL, P. 236

PAR. 190:

IN THE FIFTH LINE OF PAR. 190 BEFORE THE WORD "PLATE" INSERT THE WORD "SHELL."

MARCH JOURNAL, P. 237

PAR. 198:

IN THE THIRD LINE OF PAR. 198 TRANSFER THE WORDS "MEASURED FROM THE OUTSIDE" TO THE SECOND LINE AFTER THE WORD "DEPTH."

PAR. 199:

IN THE FIRST LINE OF PAR. 199 AFTER THE WORD "STAYS" INSERT THE FOLLOWING:

with heads not less than 1.3 times the diameter of the stays.

IN THE FOURTH LINE OF THIS PARAGRAPH PLACE A PERIOD AFTER THE WORD "PLATE" AND ELIMINATE THE REST OF THE SENTENCE.

PAR. 200:

IN THE EIGHTH LINE OF PAR. 200 CHANGE THE WORD "OR" TO "OF."

PAR. 203:

IN THE FOURTH LINE OF PAR. 203*b* IN PLACE OF THE WORDS "IN PAR. 199 WHICH APPLIES TO" INSERT THE WORD "FOR."

IN THE FOURTH LINE OF PAR. 203*d* OMIT THE WORDS "IN PAR. 199."

IN THE SECOND LINE OF PAR. 203*e* CHANGE THE WORD "OF" TO "OR."

MARCH JOURNAL, P. 238

PAR. 212:

REVISE PAR. 212*c* TO READ AS FOLLOWS:

c A cylindrical furnace which requires staying shall be stayed as a flat surface as indicated in Table 3, except that the pitch may be increased to p_1 as provided in the following formula:

$$p_1 = p\sqrt{\frac{PR}{PR - 250t}}$$

in which

p = maximum pitch measured between the centers of the staybolts in the longitudinal rows, and between the centers of the staybolts in circumferential rows, in.

P = maximum allowable working pressure, lb. per sq. in.

R = internal radius of furnace, in.

t = thickness of plate in *sixteenths* of an inch.

FIG. 12*a*:

CHANGE THE SECOND SECTION OF LETTERING AT THE SIDE OF THE CUT, FIG. 12*a*, TO READ AS FOLLOWS:

Not less than ½ t if $C = 150$ or less, and not less than t if $C = 175$.

PAR. 214:

CHANGE THE SIDE HEADING OF PAR. 214 TO READ AS FOLLOWS:

Areas of Heads to be Stayed.

ADD AT THE END OF PAR. 214 THE FOLLOWING:

In water tube boilers, the tubes of which are connected to drum heads, the area to be stayed shall be taken as the total area of the head less the area of an annular ring of width d measured from the inner circumference of the drum shell.

PAR. 215:

IN THE FIRST LINE OF PAR. 215 INSERT BEFORE THE WORD "HEADS" THE WORD "TUBE."

MARCH JOURNAL, P. 239

PAR. 239:

CHANGE THE FIRST SENTENCE OF THE LAST PARAGRAPH OF PAR. 239 TO READ AS FOLLOWS:

Where an unstayed furnace has a riveted longitudinal joint, it may be of the lap type for inside diameters not exceeding 30 in., irrespective of the height or length of the furnace. For inside diameters not exceeding 36 in., a riveted longitudinal joint may be of the lap type, provided the furnace does not exceed 36 in. in height or length.

MARCH JOURNAL, P. 240

PAR. 253:

IN THE SEVENTH LINE OF PAR. 253 BEFORE THE WORD "BOLTED" INSERT "FIRMLY," AND IN THE EIGHTH LINE AFTER THE WORD "POSITION" INSERT "BY TACK BOLTS." IN THE NINTH LINE AFTER THE WORDS "TACK BOLTS" PLACE A PERIOD AND ELIMINATE THE REST OF THE SENTENCE.

FIG. 17*a*:

CHANGE THE FIRST WORD OF THE CAPTION UNDER FIG. 17*a* TO READ "DIMENSIONS" INSTEAD OF "PROPORTIONS."

PAR. 256:

IN THE FOURTH LINE OF PAR. 256 AFTER THE WORD "BOLTS" INSERT THE FOLLOWING:

to hold the plates firmly together.

IN THE LAST SENTENCE OF THIS PARAGRAPH OMIT THE WORDS "THE TACK BOLTS SHALL BE NOT OVER 12 IN. APART AND" SO THAT THE SENTENCE WILL BEGIN WITH THE WORDS "A RIVET."

PAR. 257:

IN THE SIXTH LINE OF PAR. 257, CAPITALIZE THE WORD "CALKING," TO BEGIN A NEW SENTENCE.

BOILER CODE, PAGE 66

PAR. 261. IN ADDITION TO THE REVISION PROPOSED IN THE MARCH JOURNAL FOR PAR. 261, WHICH APPEARS ON P. 240, MAKE THE FOLLOWING CHANGES:

CHANGE THE TWO FORMULAE UNDER THE FIRST PARAGRAPH OF PAR. 261 IN THE BOILER CODE TO READ AS FOLLOWS:

For single ring: $W = \frac{(1 + 2nd)}{2t} t_1 + nd$

For double rings: $W = \frac{(1 + 2nd)}{4t} t_1 + nd$

BELOW THE FORMULAE, IN THE LIST OF DEFINITIONS INSERT THE FOLLOWING:

n = number of rows of rivets.

IN THE DEFINITION OF "S" INSERT BEFORE THE PARENTHESIS THE FOLLOWING:

in single or double shear.

MARCH JOURNAL, P. 240

PAR. 268:

CHANGE THE LAST PARAGRAPH OF PAR. 268 TO READ AS FOLLOWS:

When the maximum allowable working pressure exceeds 100 lb. per sq. in., a connection riveted to the boiler to receive a flanged fitting shall be used for all pipe openings over 3 in. pipe size.

PAR. 269:

IN THE THIRD LINE OF PAR. 269 AFTER THE WORD "RELIEVING" CHANGE THE REST OF THE SENTENCE TO READ AS FOLLOWS:

capacity of 2000 lb. per hour or less is required by the rules.

PAR. 272:

ADD A NEW SENTENCE AT THE BEGINNING OF PAR. 272 TO READ AS FOLLOWS:

272 Safety valves shall be of such a type that no failure of any part can obstruct the free and full discharge of steam from the valve.

MARCH JOURNAL, P. 241

PAR. 273:

IN THE FOURTH LINE OF PAR. 273 IN PLACE OF THE WORD "RIVETED" INSERT THE WORDS "IRREMOVABLY SECURED."

PAR. 274:

CHANGE THE SECOND SENTENCE OF PAR. 274 TO READ AS FOLLOWS:

For all other types of power boilers, the minimum allowable relieving capacity shall be determined on the basis of 5 lb. of steam per hour per sq. ft. of boiler heating surface for boilers with maximum allowable working pressures above 100 lb., and on the basis of 3 lb. of steam per hour per sq. ft. of boiler heating surface for boilers with maximum allowable working pressures at or below 100 lb. per sq. in.

PAR. 292:

IN THE FIRST LINE OF SECTION 3 OF PAR. 292 CHANGE THE WORDS "BALL CHECKS" TO "CHECK BALLS." IN THE FOURTH LINE OF SECTION 3 CHANGE THE WORDS "BALL CHECK" TO "CHECK BALL," AND OMIT THE WORD "VALVE." ALSO IN THE FOURTH LINE CHANGE THE WORDS "THE ANNULUS AROUND THE BALL" TO "THE SPACE AROUND EACH BALL." OMIT THE LAST SENTENCE OF THIS SECTION.

OMIT SECTION 4.

RENUMBER SECTION 5 TO READ SECTION 4, AND IN THE SECOND LINE OF THIS SECTION AFTER THE WORD "OPENING" INSERT THE WORDS "OR OTHERWISE ARRANGED."

RENUMBER SECTION 6 TO READ SECTION 5.

RENUMBER SECTION 7 TO READ SECTION 6, AND IN PLACE OF THE FIRST SENTENCE INSERT THE FOLLOWING:

The balls must be accessible for inspection.

IN THE SECOND SENTENCE OF SECTION 7 (RENUMBERED SECTION 6), OMIT THE WORD "ALSO."

MARCH JOURNAL, P. 242

PAR. 296:

IN NEXT TO THE LAST LINE OF PAR. 296 INSERT THE WORD "THE" BEFORE "EXCLUSIVE."

MARCH JOURNAL, P. 243

PAR. 345:

IN THE SECOND LINE OF PAR. 345 BEFORE THE WORD "WASHOUT" INSERT THE WORD "SUFFICIENT," AND AFTER THE WORD "HOLES" OMIT "FOR," AND INSERT THE FOLLOWING:

"or other openings to permit."

MAY JOURNAL, P. 400

PAR. 254:

CANCEL THE REVISION PROPOSED IN THE MAY JOURNAL AND ALLOW PAR. 254*b* TO REMAIN AS IT APPEARS IN THE MARCH ISSUE OF THE JOURNAL, P. 243, SO THAT THE ENTIRE PAR. 354 WILL READ AS IT APPEARS IN THE MARCH JOURNAL.

MARCH JOURNAL, P. 243

TABLE 9:

IN THE LAST LINE OF THE TITLE OF TABLE 9, CHANGE THE WORD "OF" TO "FOR."

PAR. 356:

ADD A SENTENCE TO PAR. 356 AS FOLLOWS:

A relief valve used on a hot-water heating boiler need not have a lifting device.

MARCH JOURNAL, P. 243
and
MAY JOURNAL, P. 400

PAR. 361:

CHANGE THE NEXT TO THE LAST SENTENCE IN PAR. 361 TO READ AS FOLLOWS:

Pipe connections to gages less than 1 in. pipe size shall be of brass, copper or bronze composition.

MARCH JOURNAL, P. 244

PAR. 374:

CANCEL THE REVISION OF PAR. 374, AND MAKE IT READ AS IT APPEARS IN THE PRESENT EDITION OF THE CODE.

PAR. 392:

CANCEL THE REVISION OF PAR. 392, AND MAKE IT READ AS IT APPEARS IN THE PRESENT EDITION OF THE CODE, EXCEPT THAT WHERE "TABLE 8" IS MENTIONED SUBSTITUTE "TABLE 16."

PAR. 422:

AFTER THE FORMULA IN PAR. 422 INSERT THE FOLLOWING:

where

W = weight of steam generated per hour, lb.
C = total weight or volume burned per hour at time of maximum forcing, lb. or cu. ft.
H = heat of combustion of fuel, B.t.u. per lb. or per cu. ft. (see Par. 427).

The Pennsylvania State College, Engineering Experiment Station, has completed a reprint from the annual report of 1913-14, in which are set forth methods of purchasing coal by specification and of sampling coals for analyses. The subject is treated of by J. A. Moyer and J. B. Calderwood. The bulletin gives the methods of gathering coal samples as used by the Bureau of Mines, Interborough Rapid Transit Co., New York City, United States Steel Corporation, General Electric Co., and Detroit United Railways, and also methods of coal sampling and analyses of the American Chemical Society and of The American Society of Mechanical Engineers.

SOCIETY AFFAIRS

A Record of the Current Activities of the Society, Its Members, Council, Committees, Sections and Student Branches; and an Account of Professional Affairs of Interest to the Membership

DURING the last month the Secretary has, by his attendance at local meetings, carried both to the Sections and to the local societies the evidence of interest, and he has received the inspiration of those meetings. The most impressive thing is, that this war is making a people of many races and opinions—a nation with a common and not altogether selfish aim. These higher purposes and thoughts have not been suddenly evolved, quite the contrary. It needed but this crisis to bring them out. The master mind of President Wilson has expressed them and, lo, the conduct of the World War has changed!

It is peculiarly consistent with the ideals of the several groups of the engineering profession that they should have joint meetings, by virtue of the tremendous part they have in the prosecution of the war and that they should come together more intimately than ever, and that all should consecrate their endeavor on the altar of freedom.

In one of the local meetings I have just attended, an army officer stated that up to the last spurt of our troops, as I understood it, about the first of April, fifty per cent of the expeditionary forces were engineer troops.

The relation of the engineer to the war is vital. He has corresponding responsibilities. Our standing as a profession will be in proportion as we meet them. Self-sacrifice is the foundation of nobility.

To my horror, an editorial in the current number of an usually excellently edited technical paper pleads that "It becomes the duty of engineers in particular to combat the theory that normal construction activities must be curtailed because of the war."

Nothing could be more false. A simple explanation will suffice to convince everyone, and especially the engineer, that all activity not contributing to the conclusion of the war must be stopped.

Belgium, France, England and Canada are 100 per cent efficient. See to it that we are likewise.

The failure of the United States to live up to her production program, while caused by many contributing factors familiar to those who read the newspapers, yet is due fundamentally to the general lack of appreciation of each individual person in this country of the fact that it is necessary to cease "normal construction." Congress is making huge appropriations, but not much more than half last year's appropriations have been expended to date due to the "normal," "business as usual" demands interfering with Government requirements.

In England during the last twenty months not one pleasure car has been manufactured! Compare this with a recent statement in the newspapers that one prominent manufacturer in the United States had cut down his output to only one-third. As a general estimate, at the present time, only one-third of the labor of this country is engaged in war work.

In order to get out the production that the Congressional appropriations provide for, we must:

a Convert all our activities to war work

b Secure an increased output of each individual, either by increased rate of execution, or by longer hours, and

c Secure the labor of 10,000,000 more people—what is termed "dilution of labor" in England.

Failure of every individual man, woman, and child to accept the absolute cessation of all "normal construction" postpones that much the date of victory.

The one man, more than any other, who is teaching this lesson to the nation is an engineer, Herbert Hoover; and while he is putting the emphasis on food, nevertheless the principle applies to every activity of every individual and is going to influence the ability of this country to conclude this war.

When we are about to do anything or purchase anything, we should ask ourselves if we can do without it. If we can, then it is a non-essential. Obviously this applies to every one of our families, and to as many others as we can influence.

To sum up, we must unite our forces, "We must produce more *and* use less—not produce more *or* use less." The supreme effort must come from the American Nation. Let us, as engineers, lead.

CALVIN W. RICE,
Secretary.

Council Notes

ON the invitation of the Philadelphia Local Committee, the Council paid an enjoyable visit to Philadelphia on Tuesday, April 23. The program was announced in the last issue of THE JOURNAL, and all the features as arranged were successfully carried out. The following is an abstract of the business meeting which was held in the afternoon.

ABSTRACT OF MINUTES

The following members were present at the Philadelphia meeting: Charles T. Main, *President;* Wm. H. Wiley, *Treasurer;* John A. Stevens, Spencer Miller, D. S. Jacobus, Ira N. Hollis, John Hunter, John H. Barr, Jesse M. Smith, C. H. Benjamin, W. F. M. Goss, Arthur M. Greene, Jr., C. T. Plunkett, D. Robert Yarnall, L. P. Alford, *Chairman Committee on Meetings;* L. C. Marburg, *Committee on Sections;* Henry Hess, *Chairman Standardization Committee,* and Calvin W. Rice, *Secretary.*

Honorary Vice-Presidents. The President reported the appointment of Honorary Vice-Presidents for the following several occasions:

National Industrial Conference Board, Hotel Astor, New York, April 18, 1918, L. P. Alford, the President and the Secretary.

National Foreign Trade Council, Cincinnati, April 18 to 20, 1918, E. A. Muller.

League to Enforce Peace, Philadelphia, May 16 to 18, 1918, R. H. Fernald and D. Robert Yarnall.

Congratulations to Sir John A. F. Aspinall. The President reported that a letter of felicitation had been sent to Sir John A. F. Aspinall, Honorary Member of the Society, upon his

recent election as president of the Institution of Civil Engineers.

Belgian Industrial Mission. The President was instructed to extend the welcome of the Society to the Belgian Government Mission on Industrial Management about to arrive in this country to study our methods and apply them in the reconstruction of Belgium after the war. The Commission has since arrived and the Society has had opportunities to assist them in their work, and the Belgian Minister at Washington, His Excellency M. de Cartier, has expressed his thanks to the Society for its efforts.

Non-Essential Industries. In response to a request of the New York Local Committee, the President was asked to appoint a Committee on Readjustment of Industries for War Work—to outline a plan in which the Society can best aid in readjusting the industries of the country to meet the needs of the war, and to report back.

Research Committee. The following sub-committees were discontinued and discharged with thanks: Clinkering of Coal, Materials of Electrical Engineering, and Safety Valves.

Boiler Code Committee. Boiler Code Interpretations in cases Nos. 187, 188 and 189 were approved with slight modification and ordered printed.

Electric Welding Council. On recommendation of the Boiler Code Committee, the following Sub-committee on Electric Welding was appointed to coöperate with and report to the Boiler Code Committee: F. L. Fairbanks, *Chairman;* F. J. Cole, J. A. Dixon, E. R. Fish, S. F. Jeter, N. W. Kellogg, William F. Kiesel, Henry Torrance.

Steel Roller Chains Committee. The progress report of the Committee, which is a joint committee with the Society of Automotive Engineers, was received and ordered printed.

Power Test Committee. The resignation of Mr. E. M. Herr from the Advisory Board of the Power Test Committee was received with regret, and Mr. Francis Hodgkinson was appointed in his stead.

Engineering Foundation. It was voted to approve the amendments to the By-laws of the United Engineering Society, providing for an increase in the number of the members of the Engineering Foundation Board, and fixing the dates of the regular meetings of the Board.

Anti-Efficiency Legislation. Letters from Mr. Henry R. Towne, past-president of the Society, and from the National Council of Industrial Defense called attention to "anti-efficiency" riders attached to appropriation bills now before Congress, which would exclude from all Government work time-study methods, bonus systems, etc. The President reported that the Engineering Council was alive to this situation, and it was voted to heartily approve any steps taken by them tending to prevent the enactment of such blighting legislation.

Letter from C. C. Worthington. A letter was read from Mr. C. C. Worthington, son of Henry R. Worthington, deceased founder of the Society, giving reminiscences of the Society and its formation.

Commission to Standardize Screw Threads. The Society having been notified of the prospective early passage of a bill to create such a commission (since passed the House, May 8), it was voted that Past-President Hartness be nominated to represent the Society on the Commission when authorized.

National Board of Fire Underwriters. In response to the invitation of the Board the President was authorized to appoint a Committee to coöperate with them in the standardization of fire-hose threads.

Adjournment was taken to reconvene on May 17, 1918, in New York City.

CALVIN W. RICE,
Secretary.

The Spring Meeting is On!

By the time THE JOURNAL reaches many of our members, sessions of the Spring Meeting at Worcester will be in progress. The prospects for a well-attended and useful meeting are excellent, and it is expected that the discussion will draw out a great deal of information that will be of material benefit to the membership. A full report of the meeting will appear in the July number of THE JOURNAL, including an account of the business transactions, the discussion upon the various papers presented, and a summary of the topical discussion on the fuel situation, concerning which a great deal of interest has been manifested, showing that the engineers of the country appreciate the need for their services in bringing about more economical use of fuel during the next winter season.

The features of the meeting were fully described in the last issue, and are here summarized for the benefit of any who may wish to refer to them in this number of THE JOURNAL.

Date of Meeting, June 4 to 7.

Headquarters, Hotel Bancroft: Part of the sessions will be held at the Hotel and part at Worcester Polytechnic Institute.

Tuesday Evening, June 4

Meeting at Hotel Bancroft, with reception following at Worcester Art Museum.

Wednesday Morning, June 5

Business Meeting, at which several important reports will be presented.

Addresses on Industries of New England.

Luncheon at Polytechnic Institute.

Wednesday Afternoon

Papers contributed by the Local Sections of New England and the Providence Engineering Society.

General Session, at which technical papers will be presented.

Session relating to courses of instruction in Safety Engineering.

Special excursions have been arranged for the ladies, including Tea at the Tatnuck Country Club.

Wednesday Evening

General War Session, with addresses on the Procurement Program of the United States Government.

Evening to close with a social time on the roof garden of the Hotel.

Thursday Morning, June 6

Session for the discussion of general technical papers.

Fuel Economy Session.

Vocational Training Session.

Thursday Afternoon

Excursion to the Norton Company's plant to inspect the community houses of that company. Luncheon served.

Brief session on Housing for Workmen.

Thursday Evening

Dinner at the Worcester Country Club.

Friday, June 7

All-day excursion to Camp Devens, Lexington and Concord, going and returning by automobile.

FREDERICK REMSEN HUTTON

FREDERICK REMSEN HUTTON, Honorary Secretary, Past-President, and for twenty-three years Secretary of the Society, died suddenly from heart trouble on Tuesday morning, May 14, when leaving his residence in New York for an automobile trip to the country. Services were held at his home on the Friday following, attended by many personal friends.

Up to the time of his death he had appeared to be in excellent health, and only the afternoon before had been in the Society's rooms, so that his death came as a shock to his many friends, who had only so lately met him in the course of their every-day duties.

Professor Hutton was born in New York, May 28, 1853. After preparation in a private school in New York, he entered Columbia College, receiving the degree of A.B. in 1873. After graduation he entered the School of Mines, and was given its degree in 1876. A year later he was appointed instructor in mechanical engineering as an associate of the late Prof. W. P. Trowbridge. This was the first recognition which Columbia gave to the important relations of mechanical engineering to other engineering courses. He entered the faculty as adjunct professor in 1881 and became professor in 1890. Upon the death of Professor Trowbridge, in 1892, the chair of engineering which he had occupied was divided, and professorships in civil engineering and electrical engineering were added to the already existing professorships of mining and mechanical engineering. Professor Hutton was made the head of the mechanical engineering department, which he directed until July 1, 1907, when he resigned, and in appreciation of his valued services was elected professor emeritus.

At the time of Professor Hutton's election to the presidency of the Society, an excellent summary of his work at Columbia was prepared by Mr. Fred. J. Miller, editor of the *American Machinist*, and published in that journal, from which the following is taken:

> Perhaps his most significant achievement during these years of service has been the development of the great mechanical laboratories of the University, during the period from 1897 to 1900, just subsequent to the transfer of the institution from the downtown site to its present location on Morningside Heights. This equipment includes the Baldwin locomotive mounted upon its testing equipment, the triple-expansion Allis-Reynolds engine, which is a three-stage air compressor, and the hydraulic equipment of the Henry R. Worthington Laboratory. A conservative estimate of the value of this equipment as installed, is not far from $100,000.
>
> It has been the professor's belief that to make experiments in illustration or confirmation of engineering formulas on engines or machines of small size, is to introduce an error not only of degree, but of kind, and that therefore the units should be of sufficient size to guard against this difficulty; and, furthermore, to make research into new fields sufficiently near to the actual conditions of practice so as not to prove actually misleading when their results are applied. The air compressor has been, with him, a favorite form of laboratory apparatus by reason of its illustrating to the student the complete cycle of generated mechanical energy, its storage in compressed air, and the liberation of that energy in a motor having a cycle similar to that of the original steam cylinder. In no other educational institution are there any larger units than those which have been here gotten together.
>
> The professor is also an earnest exponent of such a method of conducting laboratory instruction as to compel the student to exercise his thinking faculties, not only in devising the experiments and connecting up the apparatus, but in the interpretation of the results. In his discussion of this subject he has referred to the more formal system of definite instruction to the students by the use of printed logs which can be used half automatically as failing to make men out of the raw material. The automatic or log method he has called the "cook-book" system.

Professor Hutton became Secretary of the Society in 1883, three years after its organization, which was a critical time in its history. The membership was less than 400, and there was great difficulty in meeting expenses from the small sum received for dues, so that initiation fees had been treated as available current income. The previous Secretary, Mr. Rae, had received no salary and the office rent had been provided by reason of his relations with Mr. Henry R. Worthington, one of the founder members.

Professor Hutton was then a young man of thirty, Junior Professor of Mechanical Engineering at Columbia University,

THE HOUSE AT 12 WEST THIRTY-FIRST STREET; THE SOCIETY'S HEADQUARTERS DURING 16 YEARS OF PROFESSOR HUTTON'S SECRETARYSHIP

and able to arrange to give part time to the management of the Society in connection with his duties as a teacher. He was appointed Secretary in March at a salary of $1000 per annum. The Worthington office was given up and for a time the headquarters were in Professor Hutton's study at Columbia University; but it was soon found desirable to have a downtown office, and he rented at his own expense a room in what was known as the Smith Building, at 15 Cortlandt Street, and engaged an assistant whose salary he also paid. Professor Hutton states in his History that: "The location was chosen for its nearness to the ferry and approaches through Cortlandt and Liberty Streets, which were then the downtown entrances to the city from New Jersey and Pennsylvania. The

stock of volumes and extra stationery were taken to Columbia University and stored in a dark room available only for such uses. The office furniture of that modest undertaking was a Keuffel and Esser drawing table, some camp chairs and a specially designed stationery holder, somewhat along the lines of the revolving bookcases. There was no typewriter in use for more than a year. Later a bookcase made of pine, with certain locked-up cupboards, was added to receive the periodicals and exchanges."

From that time on, through the wise management and strong personality of the new Secretary, supported by the staunch founder members, who were the backbone of the organization in the early days, the Society grew and prospered consistently year by year, and one by one its many problems and difficulties were overcome. In this regard Professor Hutton displayed the same broad vision of future possibilities that so characterized Professor Thurston, who was the first President. This viewpoint was strongly emphasized by Professor Thurston's presidential addresses, which are recorded in the TRANSACTIONS.

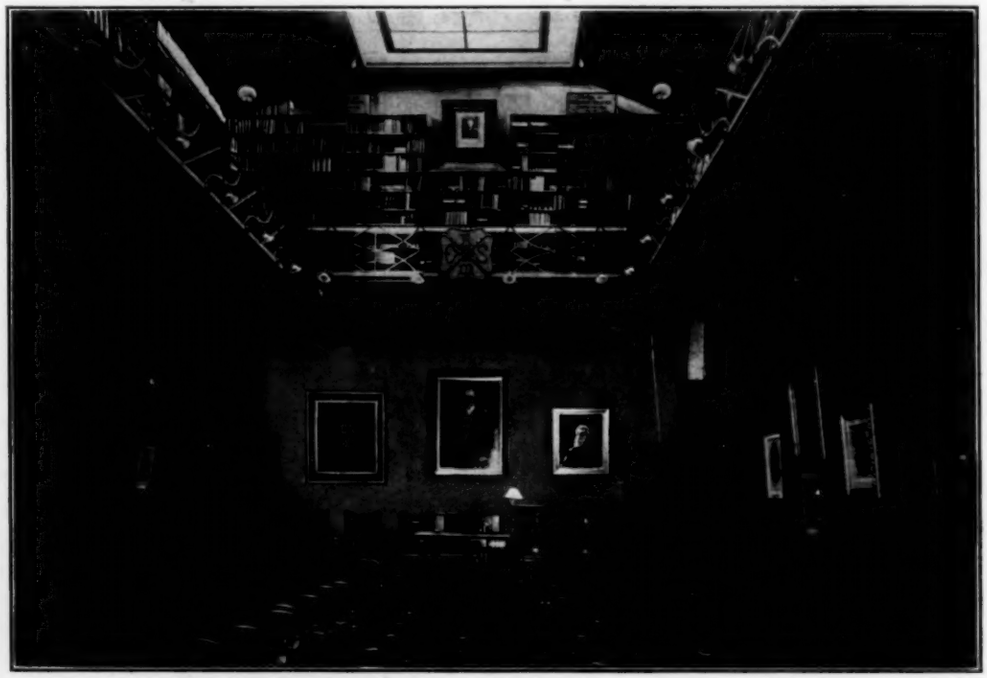
In 1890, the house at 12 West Thirty-first Street was purchased for $60,000. This had been occupied by the Academy of Medicine, now located on Forty-third Street, and was admirably adapted for a Society; but its acquirement was an ambitious project for a society without funds. The financing was left to a committee, of which J. F. Holloway, Stephen W. Baldwin and Professor Hutton were members.

Bonds were taken up by the membership to the amount of $32,000. A few of the older and wealthier members became guarantors to make good any deficiency should the Society be unable to meet its obligations, but they were never called upon, and the Academy of Medicine took a mortgage of $33,000. Five thousand dollars of the amount raised was used for alterations and furnishings.

It was this home where Professor Hutton became so closely identified with the work of the Society and formed so many pleasant associations with the members who came to the meetings or dropped in for a social time. The wisdom of acquiring the property was shown when it was sold in 1906 for $120,000, realizing a profit of nearly $60,000, and providing a fund which was a most helpful factor in procuring property for the new Engineering Societies Building, the gift of Mr. Carnegie.

With regard to the house on Thirty-first Street, Professor Hutton has written:

"It is perhaps difficult at this day and with the present strength, standing and income of the Society to realize what an enormous step and undertaking the purchase and responsibility for that house were to the modest men of that day. If it had failed, the consequences to the Society would have been most disastrous. Its success was the greatest thing that ever happened to it up to that time and for many years."



AUDITORIUM AND LIBRARY OF THE HEADQUARTERS AT THIRTY-FIRST STREET, SO CLOSELY ASSOCIATED WITH PROFESSOR HUTTON IN THE MINDS OF MANY OLDER MEMBERS

Professor Hutton's first meeting as Secretary was the Cleveland meeting in 1883, where the papers were for the first time distributed in advance by means of galley proofs, with the cuts printed on separate sheets. From time to time other events occurred which for some special reason were particularly notable. Among these was the trip to Europe in 1889, which had a wide influence in giving international recognition to the Society and establishing the bond of professional fellowship between this and the countries visited. Another was the Chicago Meeting of 1893, at the time of the Engineering Congress held during the Columbian Exposition.

Gradually the Society outgrew its quarters on Thirty-first Street, and after sixteen prosperous years moved to the splendid Engineering Societies Building, which it now occupies jointly with the other engineering societies. Professor Hutton was a member of the Joint Conference and Building Committee appointed to carry out the generous intention of Mr. Andrew Carnegie to provide a necessary building for the use of the several societies and a building for the Engineers' Club, and

to plan the proposed structures. He was also Secretary of the Building Committee, and later Secretary of the United Engineering Society. From the fact that the Civil Engineers decided to remain in their own building and the Mining and the Electrical Engineers had no buildings of their own, a great many meetings of the Committee, of which a total of seventy-four were held, besides numberless conferences, took place in the house of the Mechanical Engineers on Thirty-first Street, and during the construction much of the accounting and other business was transacted there.

Professor Hutton was one of the Board of Trustees of the United Engineering Society, which is the holding corporation for the building.

At the end of twenty-three years' service and coincident with the removal to the new building, Professor Hutton resigned his position as Secretary. He felt that the time had come when the Society needed the full time and energies of a secretary, and should not be compelled to share these with the engineering department of a university. It seemed proper that the retiring secretary, who had led the Society from the modest beginnings where he paid the office rent out of his own pocket up through the successive stages of development, to the point where it constituted a prime element in a great engineering headquarters for the whole country, should be elected to the presidency. He was made President for the year 1906-1907, and officiated in that capacity for the first time at the Indianapolis Meeting in 1907. At the end of his term he took for his presidential address the subject of the Mechanical Engineer and the Functions of the Engineering Society.

In 1908 he was elected Honorary Secretary, under the constitutional provisions which created such an office, a distinction which he held until his death.

With his varied and complex duties at Columbia University and in the secretary's office of the Society, it was impossible that he should enter largely into literary productions, but, nevertheless, he was the author of several books and several papers presented to the Society. The earliest of these was an elaborate monograph on Machine Tools for the Census of 1880. At that time technical books were few and engineering periodicals were fewer, and this treatise on machine tools stood out as one of the important documents of the time, and was used by engineering schools for the instruction of their students.

He wrote two textbooks, on Mechanical Engineering of Power Plants and on the Gas Engine. A distinctive and valuable feature of the former was the summarizing of the advantages and disadvantages of the various types and combinations of apparatus used in power plants. He was editor for encyclopedias and dictionaries, notably the Century, of 1911.

Fortunately for the Society, Professor Hutton was prevailed upon to write its history, which was issued by the Society in a handsome illustrated volume in 1915. While the volume is in no sense biographical of any one individual, and refers to Professor Hutton by name in only a few instances, it must, nevertheless, be regarded as largely a history of his own endeavors and accomplishments, and will long remain a valued and cherished volume to many of his friends and fellow-members. Special attention should be called to the chapter on Some Principles of Society Philosophy, which embodies a remarkably comprehensive statement of the stages of development of a great engineering society and the principles underlying them.

In 1911 Professor Hutton served as consulting engineer to the Department of Water, Gas and Electricity, New York City, and from 1905 to 1911 was vice-chairman of the Museum of Safety. He was consulting engineer to the Automobile Club of America and chairman of its Technical Committee from 1912, in which capacity he supervised the important testing work conducted by the club in its laboratory. He was one of the first engineers to use an automobile and to enter into a study of automobile construction.

In many ways since serving as President, Professor Hutton has been active in Society affairs, particularly as a member of the Committee on Constitution and By-Laws. In this work he endeavored to meet in a broad and progressive spirit the new conditions which were imposed upon the Society by its growth and expansion into various fields of activity and the establishment of its many Sections. He had, as always, a clear vision of the future and laid his plans accordingly. He was also a member of the John Fritz Medal Board of Award. His interest in young men was evidenced by his service on the Student Branch Committee of the Society. He has often presided at meetings and represented the Society on special occasions, which he always did with a distinction and grace of manner peculiarly his own. Here, as on all occasions, his felicity of expression and ready wit, his cordiality and withal his dignity, were strong characteristics.

In 1882 Columbia conferred upon him the degree of Ph.D. and in 1904 the degree of Sc.D., which is the highest distinction which the University places upon one for scientific and engineering training.

Professor Hutton is survived by Mrs. Hutton, who has so often been present with him at the Society's social functions; and two sons, Dr. Lefferts Hutton, now regimental surgeon in the army, with rank of Major, and Mancius S. Hutton.

The following are letters of appreciation received from friends of Professor Hutton, members of the Society.

LETTERS OF APPRECIATION

There was no one, in my estimation, who contributed more to the successful upbuilding of the Society than did Professor Hutton. He was absolutely untiring in his efforts, and even when he had gone to the mountains for his well-deserved summer rest, he kept the interests of the Society before him, and was of the greatest assistance in its work.

Professor Hutton's services as Chairman of the Committee on Constitution and By-Laws showed the greatest interest and devotion. These documents, under which we are at present acting, are evidences of his handiwork and wise judgment in almost every line.

There is much more I could say, but as there will be plenty of testimony from others I will only add that the Society showed its appreciation of his efforts in its behalf by conferring upon him all the honors within its gift. The history of its early struggles, which Professor Hutton wrote personally, remains as a monument to his memory; and indeed it would be hard to look into the archives of the Society without finding some evidence of his work.

WM. H. WILEY.

In the death of Frederick R. Hutton, we have lost one who has most worthily represented the Society in its ideals, traditions and active work.

During all of the years of service as Secretary, President, and Honorary Secretary, he was unremitting in his efforts to have the activities of the Society maintained on a high plane, both among its own membership and their relations to the public.

It was always he who was called upon to represent the Society on special occasions, which he did with such rare grace and wonderful expression.

He has always seemed to be an integral part of the Society. We shall all miss him, particularly those who have been associated with him these many years.

CHARLES T. MAIN.

The American Society of Mechanical Engineers in parting with Frederick Remsen Hutton loses one of its best beloved, highly respected and most valuable members.

No man has done more than he in guiding and keeping the

Society to its high ideals. In the earlier years he, with other high-minded engineers, set the standards of these ideals. He was ever watchful that they be not lost to view.

His devoted and willing services to the Society as Secretary, President, Member of Council, in many committees and notably in the Committee on Constitution and By-Laws, have left their indelible imprint on the history of the Society.

The Society will long remember and greatly miss his wise counsel, his genial manner and gentlemanly bearing, always fair and considerate.

May his influence still remain with us.

JESSE M. SMITH.

We who for years have been active in the A.S.M.E. heard with profound sorrow of the death of Dr. Hutton, for many years the efficient Secretary of our Society and then President and Honorary Secretary.

The Society owes a real debt of gratitude to Dr. Hutton for his services so effectively and tactfully rendered to the Society and the cause of engineering in general.

ALEX. C. HUMPHREYS.

All of us who knew him well can but deeply mourn the untimely death of our genial friend, Professor Hutton. Leaving to others an expression of appreciation of his work as a teacher, a research worker, a writer and one of the most successful of secretaries of a great engineering society, I will speak of his kindly spirit, his gracious manner and his attainments and accomplishments, in music, in oratory and in other lines of social and domestic life. His talk and his work, moreover, were spiced with a vein of humor which made him a delightful companion. All of this personal equipment doubtless tended toward the success of his earnest life work in connection with the many branches in which he was so ardently engaged.

OBERLIN SMITH.

Those of us who know something of the situation in 1883, when Professor Hutton became Secretary of The American Society of Mechanical Engineers, realize just what his work meant to us and what it will continue to mean so long as the Society exists.

Called to assume charge of its affairs at a time when its finances were inadequate to its expenses, when its publications were in arrears, when its membership was small and scarcely increasing, when its future lay in the balance, he gave to its recuperation an effective energy which never slackened for more than twenty years, and which, more than any other thing made the Society what it is today.

In those days Professor Hutton *was* the Society, for the able men who stood back of him could give but a small portion of their time to its affairs, while he stood before the membership as the one man who knew them all, greeted them all, welcomed them all, whose presence put life into otherwise dreary meetings, and whose judgment and untiring effort finally put the Society in a position where he could relinquish its guidance to others with a position so fully assured that failure had become impossible.

HENRY HARRISON SUPLEE.

The sudden death of our old-time friend and Honorary Secretary of the Society, Professor Hutton, is indeed sad news, and while I cannot at this moment do more than to express my sorrow and sympathy in this loss, to his family, to the Society and to his many personal friends, by so sudden a termination of his active life, and to state how greatly we shall all miss his ready and well-chosen words when voicing the feeling and sentiments of the members of the Society at meetings, as Secretary and as President, or at our many functions, abroad as in 1889, or in this country.

The results of the work he did in building up the prestige of the Society during its earlier years, and for many years since, while he was Secretary, are manifest in the position which the Society now holds in the broad field of engineering.

His uniform courtesy and cheerfulness under many trying conditions, will also be gratefully remembered by all whose good fortune it has been to know him personally. I certainly feel that in his death is the loss of a friend.

GEO. M. BOND.

I am confident that all the members of the A.S.M.E., from the time when Professor Hutton first became Secretary, have pleasant and delightful memories of him as our secretary and friend. His excellent and expert use of the English language was a continual example to those of us who made so many mistakes in our use of the mother tongue, and I believe we all use better language from having heard him speak. As an example, one item of his literary work is shown in the resolutions given by our Society to our British cousins following the acceptance of the invitation of the British Society in 1910.[2] Professor Hutton's keen sense of humor always kept us in good spirits. I remember on the occasion of our Annual Meeting in 1898 in the old society house on 31st Street, when I was sitting beside him, one of the largest members began to get up to discuss a subject then before the Society and I whispered to Professor Hutton, "He will now tell us what he did twenty-five years ago." The member began his remarks—"In 1872," and Professor Hutton instantly turned to me and said, "You're wrong, it's twenty-six."

The pleasant and delightful memories of Professor Hutton would fill a large volume and I wish those interesting episodes in his life which made us all happier were published. We all mourn his death and we all will cherish his memory.

WORCESTER R. WARNER.

Professor Hutton's sudden death is a great shock to me, particularly because when I saw him last, which was during the December, 1917, meeting of the Society, in New York, he appeared to be in splendid health, and full of his usual energy and spirit.

I know that the older members of the Society fully realize and thoroughly appreciate how much of the Society's present prosperity and high standard is due to Professor Hutton's devoted service during the long term of years which he served as its Secretary. I, as President of the Society, enjoyed greater opportunities of knowing, and thus appreciating, not only his work, but the loyal spirit and unselfish devotion to his duties, and also his wonderful tact and patience in meeting the many trying conditions which so constantly occurred.

The Society has passed through several strenuous periods, to emerge from each one stronger and more useful to its membership, and therefore to the whole engineering profession. One such period occurred during my presidency in 1891, when it became evident that its rapidly increasing growth, not only in membership, but also in the field of the Society's activities, and consequent usefulness, made a greater revenue imperative; therefore the question of lessening its activities and thus restricting the benefits to be derived from membership in it, or augmenting its income through increased dues, became a vital one. While the situation would seem to have been a plain one, the views of the membership were not at all alike—all earnest in their desire for the Society's good, but differing as to the proper ways and means. Secretary Hutton's position was a trying one, and only a man possessing his courage and certainty of being above just reproach, joined with never-ending patience and willingness to acknowledge the right of others to hold views differing widely from his own, could have met the situation in so successful a manner as he did.

ROBERT W. HUNT.

I have no doubt whatever that the entire Society shares with the Council a deep regret over Professor Hutton's death. His connection with the foundation of our Society and his long service to the Society and the individual members, have given us all a deep sense of gratitude for his effective work in putting the science of mechanical engineering upon a professional basis. I consider that his most important contribution. I feel a strong personal loss through a long acquaintance with him as a teacher at Columbia. He ought to stand to us all as the finest type of teacher, servant of the public, gentleman and scholar.

IRA N. HOLLIS.

Dr. Hutton's death removes a familiar and beloved personality from the activities of the Society. To those of us who had enjoyed the privilege of his friendship from the early days of the Society it counts as a personal bereavement.

For many years his work as Secretary made him the outstanding feature in the Society. Presidents and councillors had their day and passed on, often unknown personally to the majority of the members, but he remained, known to almost every member. He was admirably fitted for the work by his ability and engineering knowledge, but above all by his social qualities. His wonderful memory and sympathetic interest were a powerful aid in keeping up the membership in our days of adolescence and struggle. Nor

[2] Trans., vol. 32, 1910, p. 626.

did they lose their charm in more recent times when he had, with advancing years, reduced his activity but not his interest; his position as Honorary Secretary affording large opportunity for their exercise.

Other tributes will undoubtedly speak of his broad culture, his great felicity of expression, and his active detailed work for more than a score of years in caring for the interests of the Society and establishing the tone of the TRANSACTIONS at a high level. To those of us, however, who attach great importance to the human side, it will always seem that his greatest work was in the promotion of acquaintance and good feeling among the members, thereby assuring a steady growth in numbers and in *esprit de corps*. It is, perhaps, not going too far to say that the Society is his monument.

W. M. MCFARLAND.

In the passing from earth of Professor Hutton I have lost a warm personal friend, The American Society of Mechanical Engineers has lost one of its devoted and untiring members, the engineering profession a distinguished representative and the country one of its best and most able citizens.

I have known Professor Hutton ever since the Cleveland Meeting in 1883, the first that he attended as Secretary. At that meeting he showed those qualities that have meant so much to the Society in the quarter of a century during which he was Secretary. Both in this country and in foreign countries we have always been proud of the part he has taken in representing the Society and the engineering profession, and in these later years as Honorary Secretary he has ever been ready to devote his time and thought to the problems of the Society. Among the many important services he rendered was the writing of the valuable history which we now possess, and in the great progress that has been made in recent years in coördinating the various branches of the engineering profession he has always been most helpful and sympathetic.

His life was one of service to his fellow men and in the highest sense he was a noble Christian gentleman.

AMBROSE SWASEY.

My acquaintance with Professor Hutton began with my membership in the Society. His efficiency as the Society's Secretary early made an impression upon me which the passage of years and the riper acquaintance incident thereto have not impaired. He was masterful in presenting the business of a meeting: in voice and manner, in skill and courtesy, he was altogether charming and his presence made significant proceedings which without him would have passed without notice. His theories concerning the conduct of Society affairs were based upon broad conceptions and generous procedures. Probably few of our younger members appreciate the extent to which in the early days Professor Hutton contributed to the Society's upbuilding.

W. F. M. GOSS.

Through the death of Professor Hutton the Society has lost one of the grand Old Guard who founded and brought it to its present position and power. Always working with its welfare at heart, the Society will be forever a living monument to his endeavors. His cheerfulness and fair-mindedness overcame many an obstacle that might have led to disaster in less tactful hands. He will be remembered with honor by all and by his most intimate friends as a scientist who nurtured the flower of faith, a truly Christian gentleman.

D. S. JACOBUS.

The following telegrams were received:

My belief, based on thirty-five years' membership in our Society, is that Professor Hutton, by his delightful personality, alert sympathy, remarkable memory of men's faces, and kindly greetings to all, no less than by his engineering knowledge, contributed tenfold more than any other one man to the success of our great Society in the formative period of its first twenty years. I deeply mourn his loss.

JOHN R. FREEMAN.

Professor Hutton still lives. The prestige of the Society resulting from his twenty-five years of effort as Secretary was the foundation for the Society's further scope and usefulness. As an influential officer of one founder society and Secretary of the United Engineering Society during its formative period, Professor Hutton therefore contributed in a large way to the enhancement of the engineering profession in America.

CALVIN W. RICE.

In the passing away of Professor Hutton The American Society of Mechanical Engineers has lost not only one of its honored members; not only one of the first authorities in the science of engineering; and not only one whose work and personal influence will undoubtedly be considered by future historians of the Society as most potent in molding the character of the Society toward these highest standards to which it will ever be faithful, but it has lost one of its most beloved and esteemed members, and one who was ever radiant with that cordiality and inspiration so essential in the building of a society. It leaves an example to the remaining members, especially the younger and more active members, of the noblesse and great value of Professor Hutton's characteristics to the success of the Society and the country that it represents and serves.

JAMES HARTNESS.

One of the saddest messages received in many years was the announcement of the passing away of our past President and associate, Professor Hutton. I have been a guest at his fireside and always made welcome there. Our Society owes much of its high standing to our good friend who has gone from among us and his memory will always be cherished by its members.

JOHN A. BRASHEAR.

Classification of Trade Personnel

A work of almost incalculable value in classifying trades has been completed for the War Department by John J. Swan, Mem.Am.Soc.M.E., of the Trade Test Division of the Committee on Classification of Personnel in the Army. It is known as War Department Document aid in classifying skilled men who may be drafted or enlisted into the National Army, so that the right men can be selected for any required occupation in connection with the technical departments of the army.

There are 565 classifications, each of which is defined both as to the duties to be performed and the qualifications of a well-trained, high-grade man or journeyman (this is sometimes an expert or a foreman) who can do the work required. The classification also gives the nearest equivalent or substitute occupations which can be drawn from in case it is necessary to secure an additional supply of any particular kind of labor.

This is probably the first elaborate vocational analysis which has been published. The system has been taken up by the U. S. Department of Labor, and is being used first of all to cover the munitions industries, but later will be applied to all trades and industries. It has also been adopted by a large number of manufacturing firms. Only those who have attempted such a task can appreciate the amount of work involved in compiling so large a mass of material.

Submarine Engineer Officers Wanted

The Navy is in need of professional engineers for submarine duty, not over 35 years old and physically strong. The qualifications include citizenship in the United States, the degree of mechanical, electrical or mining engineer from a university of recognized technical standing, and at least two and one-half years' practical engineering experience. The candidates selected will be commissioned Ensign in the U. S. Naval Reserve Force, and will be sent to the Naval Academy and to the Submarine School in New London for a special technical course.

Engineers subject to the Selective Draft Law and those now in the Army are eligible. Letters from at least three responsible personal acquaintances must accompany each application. Address the American Engineering Service of the Engineering Council, Room 903, 29 West 39th St., New York City. Early responses are requested.

Tribute to John Porterfield Sparrow

At a recent meeting of the Committee on Flanges and Pipe Fittings of which the late John Porterfield Sparrow was chairman at the time of his death and whose obituary notice was published on page 328 of THE JOURNAL for April, the following tribute was paid to his memory:

John Porterfield Sparrow, Chief Engineer of the New York Edison Company, a member of the American Society of Mechanical Engineers and Chairman of its Committee on Flanges and Pipe Fittings, died March 18, 1918.

Mr. Sparrow was one of the best-known mechanical engineers in the United States, particularly in the modern power-station field.

His deep study into the intricate details of his work have brought forth improvements and economy in the power-plant field of inestimable benefit to mankind.

His patience, courtesy, sterling honesty and ripened judgment were sources of pleasure to all who came in contact with him.

His death is a severe loss to this Committee, which can only be filled by the softening influence of time.

Great Canadian Reflecting Telescope

Every member of the Society feels a personal pride in the successive scientific attainments of "Uncle John" A. Brashear, who became endeared to so many during the year of his presidency. A few have known of the suspense under which he has been laboring in the difficult task of grinding and polishing the glass for the great Canadian Reflecting Telescope; and all should now know of his happiness and relief at the successful completion of this undertaking. Not only is the glass finished, but it has safely arrived at the Canadian observatory at Victoria, B. C. In a letter, Dr. Brashear writes: "The glass reached its destination in less than six days after I bid it good-bye on the car in Pittsburgh, a trip of 2200 miles. You bet Uncle John and his son-in-law and some others are happy over this 'news,' after three years and eight months." The following article from a Pittsburgh paper gives some interesting facts:

This precious glass, which took nearly four years in the grinding, polishing and correction of its accurate parabolic surface, required great care in packing and shipping, the glass disk alone weighing 2¼ tons, and in its iron cell nearly three tons; the packing case weighed not far from a ton.

The order for the big disk of glass was given to the St. Gobain glass works in France, but it was cast in their factories at Charleroi in Belgium, sent to Antwerp, placed on the ship, the *Vaterland*, and left Antwerp just a week before Germany declared war.

The first grinding of the glass required over two months. This was done to get it into shape for the finer grinding and polishing. About four hundred pounds of glass were removed from the upper and lower surfaces and the edges, leaving the dimensions as follows: Diameter, 73 in.; thickness, 12 in.; opening in center, 10⅛ in. in diameter; curvature, a radius of 60 ft.; the focal length of the telescope used in the Newtonian form, 30 ft.; in the Cassegrain form, about 108 ft.

After this preliminary work on the great glass, it was taken to the basement of the workshop, where the temperature conditions could be kept constant, and where the great tube with its double walls had been constructed on which all the final tests were made. Here Mr. McDowell took entire charge of the polishing and correction of the parabolic front surface, having as his right-hand assistant, Mr. Fred Hageman.

After polishing for a few hours with a large polisher, the glass had to be lifted into the testing tube, and an interval of at least 10 hours had to be allowed before the effect of the polishing could be studied, because of the disturbance of the surface by the heat produced in the polishing process.

As the surface came nearer and nearer to the true figure, smaller polishers were used over zones standing up, possibly one-hundred thousandth of an inch or less. This is what is called local polishing and is always done by handwork. Sometimes the local work lasted for only 15 to 20 minutes, then the huge glass had to be lifted into the testing tube to wait until the surface worked upon came to the normal temperature of the entire mass of glass. Patience as well as consummate skill is an imperative factor in this delicate work.

After over three years of delicate working, waiting and testing, by methods of marvelous accuracy, Dr. Plaskett, the astronomer of the Dominion of Canada, pronounced the parabolic curve almost twice as good as the specifications called for. The error allowed, which is practically beyond the limiting error that can be detected when used in the telescope, is one two hundred and fifty thousandth of an inch, while the greatest error that could be found in the surface was one four-hundred thousandth of an inch and in some parts of the surface not over one-millionth of an inch. In using some of the smaller polishers, not over one five millionth of an inch from any one part of the surface was removed.

Many people think only of the magnifying power of a telescope, but this is an erroneous idea. Its greatest value is as a collector of light from, let us say, some distant star cluster, and as this glass is over 4000 in. in area, it will gather and concentrate 100,000 times more light from the distant star than the human eye.

The mounting has been erected for some months at the Victorian Observatory and is a wonderful model of the highest efficiency in modern mechanism, made by the Warner and Swasey Company, Cleveland. The instrument complete weighs fifty-five tons, and the great reinforced cement piers supporting the axes weigh about 500 tons. The moving parts, with the great mirror, weigh about thirty-five tons, and these moving parts are all handled and controlled by electric current. Indeed, so delicately is the great telescope, with its massive parts, moved to follow a star or any heavenly body that the power required to light a 16-cp. electric lamp does the work.

The Victoria Observatory is situated about eight miles from the city, in one of the most beautiful sites on the Pacific coast. It was selected after many studies as to the best condition for astronomical research in Canada, the question of minimum change of temperature and minimum cloudiness being important factors in the selection of the site.

First American-Built "Tank"

The clipping which follows relates to the army tank *America*, of which papers throughout the country have published illustrations during the past month. It is one of the largest and heaviest tanks which has yet been constructed, weighing 45 tons. It is a steam, oil-burning tank, and the same size as those now used in Europe—35 ft. long and 11½ ft. wide.

Prof. E. F. Miller, Mem.Am.Soc.M.E., head of the Mechanical Engineering Department at the Massachusetts Institute of Technology, designed the huge war machine, in which it is said the *Brittania*, the British tank which recently visited Boston, could be stored without the least trouble. The construction work was done under the direction of Col. Francis R. Shunk, department engineer of the Northeastern Department. Major Henry Adams, Engineers Corps, N. A., assistant department engineer, was in executive charge of the work. Capt. Albert S. Smith, Superintendent of Buildings and Power at the Institute, was chief construction engineer. The construction work was done in the stockade in the rear of the Institute, where machine shops have been installed.

The American army engineers took full advantage of the experiences of the English engineers and improved upon the British type in many ways, eliminating features and designs which were proving impracticable in the big war engines of Europe and adding many distinctive American engineering improvements, so that the *America* stands out as a peer of all war engines and a monument to American ability and ingenuity.

The plans for the new American tank are now available for use in other factories where the Government is turning out tanks and engines, and the *America* is but premier of a great fleet.

The American "tank" service has started a drive in Boston for recruits between eighteen and forty-five, whether registrants under the selective service law or not. The tank corps, which has opened its office at 3 Tremont Row, is one of the newest and most attractive parts of Uncle Sam's fighting machine, and is one of the few open to men above the draft age. (*The Tech*, April 20, 1918.)

The John A. Stevens Trust Fund

IT is fitting, now that the details of arrangement have been completed, that announcement should be made of the establishment of the John A. Stevens Trust Fund through the generosity of Mr. John A. Stevens, a member of the Council of the Society and Chairman of the Boiler Code Committee.

The fund consists of a $15,000 insurance policy which Mr. Stevens has taken out with the Connecticut Mutual Life Insurance Co., Hartford, Conn., and which will eventually be turned over to the Society. The net annual income accruing from this fund will then be allotted annually in equal shares to the person or persons who have that year invented or been responsible for an invention of noteworthy progress in the art of engineering having to do with the conservation of fuels in the generation of light, heat and power. If there should be no special processes evolved during any particular year, the net annual income is to revert to the person creating or being responsible for any engineering safeguard having to do with the protection of life and property.

Mr. Stevens has become widely known among our members and throughout the country as chairman of the A.S.M.E. Boiler Code Committee, a position which he has held since the inception of the committee in 1911. He had previously been a member of the Massachusetts Board of Boiler Rules, and this experience, combined with his varied practical experiences in the steam-engineering field, both marine and stationary, splendidly equipped him for the new standardization work, the most important by far which our Society has attempted.

Since 1909 Mr. Stevens has been in private consulting practice at Lowell, Mass., during which time he has superintended the construction of many power plants, made analyses of several large properties, and introduced a number of innovations in the line of power engineering. For 13 years previous he was chief engineer of the Merrimac Manufacturing Company, Lowell, Mass., where he practically rebuilt the entire steam installation, and also superintended the power work of the company's southern mills. This connection gave Mr. Stevens an intimate acquaintance with every phase of New England mill practice, and the large steam and power plants and distribution systems so important in this great industry.

The basic work of his life, however, was accomplished on shipboard, beginning when a young boy with the arduous duties of a fireman on a lake dredge, and closing in 1896 as a junior first assistant engineer on the transatlantic liner *St. Paul*. While engaged in marine work he served as engineer on several of the largest boats both on the Great Lakes and on the Atlantic Ocean, and it was characteristic of him that he lost no opportunity to acquire an intimate knowledge of marine practice, even though at a sacrifice in salary; for example, when first assistant engineer of the steamship *Illinois*, sailing between Philadelphia and Antwerp, he changed to the position of fifth engineer of the *New York* in order to become acquainted with the machinery of this larger and more modern vessel.

Besides serving as fireman on the lake dredge when a boy, he managed to complete a full machinist's apprenticeship in a shop doing a wide variety of construction and repair work, and later worked as journeyman. He recounts how, having reached this point, his mother prevailed upon him to complete his education, and how he took a full high-school course and a year at the University of Michigan. Finding, however, that mathematics was not his forte, he resolved that he would rather be a "first-class man in an engine room," where he had already met with success, than a "second-class man in a designing room." Therefore, securing a leave of absence from the university, he enlisted as second engineer on one of the lake steamers, a branch of the profession which he followed closely until he became connected with the Merrimac Company at Lowell. At the age of twenty-seven he secured an ocean steamship's unlimited license.

The trust fund which Mr. Stevens has established is in recognition of the opportunities for acquiring experience and for promoting the welfare of the engineer and his work which he has always found to exist in the engineering field; and as an incentive to the young engineer to develop further the field of light, heat and power with which he himself has been for so long identified.

JOHN A. STEVENS

Award of Medal by Cotton Manufacturers' Association

In 1898 the board of government of the New England Cotton Manufacturers' Association established the Association Medal, which was to be awarded to any person whose work would be of sufficient importance to the purposes for which the organization was devoted, including any papers read before the Association, the production of any mechanism or processes in the fabrication, design or finishing of cotton goods, comprising mill construction, the generation of power and its distribution, or any of the works tributary to cotton manufacture.

At the joint meeting of the American Cotton Manufacturers' Association and the National Association of Cotton Manufacturers held in New York, May 1 to 3, a medal was presented to Mr. Stevens for his paper on the Evolution of the Steam Turbine in the Textile Industry, which had been given at the annual meeting of the National Association of Cotton Manufacturers held in Boston, Mass., April 25 to 26, 1917. This paper was one of exceptional interest and value, in that it outlined with striking forcefulness the advantages of the steam turbine as it has been lately developed, for use in the power plants of textile mills. The author referred in detail in his analysis to the various economic developments in turbine design, embracing the low-pressure, mixed-pressure and extraction turbines, which features have undoubtedly been potent in

bringing this form of prime mover into more general use in mills where low-pressure steam is required in various processes. The paper also placed on record some most interesting and valuable information concerning the use of geared turbines for direct driving of mills, in the adaption of which the author and his associates have had much experience. It concluded with a description of a water-tube boiler of immense size which was developed by Mr. Stevens conjointly with Arthur D. Pratt, Mem.Am.Soc.M.E., which, it is predicted, would have effected a marked advance in large power-plant methods had it not been for the setback to industrial development resulting from the war. This boiler was described and illustrated in THE JOURNAL for July 1917.

In making the award, therefore, the Association states that it is "not only for contributing the most to the advantage of the cotton industry during the year, but for large conservation of coal and men made by the people using his services during the past years."

The obverse of the medal bears the names of the Association and the dates of its foundation and incorporation. In the middle is a loom of the pattern in general use at the time of its foundation, and this loom is surrounded by a garland of cotton bolls. The name of the Association in mural text is girted by a polygon of hanks of yarn knotted together.

The reverse side bears a chaplet of oak and laurel leaves, symbolizing strength and honor, and secured at the base by an American eagle with outstretched wings, the whole forming a frame for the tablet containing the inscription.

Cullom Medal for Dr. F. H. Newell

To Dr. Frederick H. Newell, Mem.Am.Soc.M.E., the American Geographical Society has awarded the Cullom Geographical Medal. This gold medal has been given from time to time to explorers, writers and men who have contributed in important ways to the advancement of geographical knowledge. The last recipient of the medal was General George W. Goethals, in recognition of his services in connection with the Panama Canal. Others who have been honored by the receipt of this medal are Admiral Robert E. Peary, Fritdjof Nansen, Sir John Murray, the Duke of the Abruzzi, Sven Hedin, and Sir Ernest H. Shackleton, every one of international and cosmopolitan reputation.

Professor Newell's accomplishment is perhaps best expressed by the inscription on the medal, which reads:

FREDERICK HAYNES NEWELL

Organizer and Director
of the
United States Reclamation Service
1907-1914

He carried water
from a mountain wilderness
to turn the waste places
of the desert
into homes for freemen.

Pennsylvania can claim Professor Newell, but during his studies both at grade schools and the Massachusetts Institute of Technology, as well as at other times, he has been closely identified with Boston and its institutions. His work at the Institute was in mining engineering, with post-graduate studies, for his doctor's degree, in geology and hydraulics. Three years after graduation he became an assistant in the U. S. Geological Survey and shortly afterward was given for his special work the study of the irrigation of arid lands. From a division of the U. S. Geological Survey the specialty was developed into a separate service, the Irrigation Service, of which Professor Newell was made director by President Roosevelt in 1902. Till 1914 he remained director of this service, the engineering works of which are of highest rank. He outlined and developed the splendid plans of the Reclamation Service with its great dams, basins and waterways. In May 1915 he was appointed by the University of Illinois head of the department of Civil Engineering.

Presentation of the Edison Medal to Col. John J. Carty

Dr. John J. Carty, colonel in the United States Army Signal Corps, chief engineer of the American Telephone and Telegraph Company and past-president of the American Institute of Electrical Engineers, has been awarded the Edison Medal in recognition of his services in developing the science and art of telephone engineering.

The medal was presented on Friday evening, May 17, at the annual meeting of the American Institute of Electrical Engineers in the Engineering Societies Building in West 39th Street, New York. After a statement of the history and significance of the medal by Dr. A. E. Kennelly, Chairman of the Institute's 1917 Edison Medal Committee, Dr. Michael I. Pupin, of Columbia University, told of the work of Colonel Carty which has made him preëminent in the field of telephone engineering. The medal was then presented by the President of the Institute, E. W. Rice, Jr., also president of the General Electric Company.

The Edison gold medal was founded in 1904 by the Edison Medal Association, an organization composed of old associates and friends of Thomas A. Edison. It has been awarded annually since 1905 by a committee of 24 members of the American Institute of Electrical Engineers, the recipients in order being Elihu Thomson, Frank J. Sprague, George Westinghouse, William Stanley, Charles F. Brush, Alexander Graham Bell and Nikola Tesla.

Colonel Carty is well known as the engineer of the great transcontinental telephone line, and as the engineer who made possible wireless telephoning over distances up to 5000 miles. Since 1916 he has coöperated with the Signal Corps of the Army and with the various departments of the Navy in making arrangements which would insure the readiness of the great telephone system of his company for military service in case the United States became involved in the world war. Last year saw these plans put into active use with a marvelous degree of success. He is now giving much of his time to the development of the nation's Signal Corps work in this country and abroad.

Library Service Bureau

As the knowledge of the facilities of the Engineering Societies Library to serve members of the engineering societies and the engineering profession outside of New York—and sometimes in New York—through its Library Service Bureau increases, the requests for such service correspondingly increase. From January 1 to March 31 of this year the Bureau conducted 135 searches; 32 of these were made in mechanical engineering, 29 in mining and metallurgy, 21 in civil engineering, 18 in chemical engineering, 10 in electrical engineering, and 25 miscellaneous. The Library also made 24 translations in the same period, and supplied 615 photostatic prints.

AMONG THE LOCAL SECTIONS

DURING the past month Mr. Calvin W. Rice, National Secretary of the Society, and Mr. Ernest Hartford, Secretary of the Committee on Sections of the Society, visited a number of the Sections where meetings were held. Many of these meetings were well attended and much enthusiasm was evoked. All presented a patriotic atmosphere, and everywhere the enormous part played by the engineers in winning the war was the dominant feature.

At Meriden, Conn., where a paper was presented on the Browning machine gun, over 175 were present; at Bridgeport over 200 attended and at Boston over 400 gathered. The Detroit meeting developed action regarding the development of intensive courses for training women at technical colleges and schools, so that they may serve as draftsmen and tracers, or as inspectors in munitions and industrial plants.

At New York the vital question of labor turnover was taken up in a way that emphasized the opportunity of the engineer to take a leading part in the solution of this vital problem. Engineers are the connecting link between labor and capital in the large majority of the industries of the country, and it is hoped other Sections will follow the lead of New York in arranging meetings on this subject.

In addition to attending Section meetings at Indianapolis, Cincinnati, New Orleans, Chicago and Toronto, and a joint meeting at Birmingham of the Atlanta and Birmingham Sections, Mr. Rice attended meetings of engineers at Toledo, Dayton and Duluth. He found everywhere throughout the West and South that the engineers and people generally were thoroughly alive to their responsibilities, and the consensus of opinion was that meetings of engineering organizations were of great value in maintaining a proper morale and in building up an *esprit de corps* in the profession.

The Providence Engineering Society and Its President

In THE JOURNAL for March 1918 was published a group of portraits of the chairmen of the Local Sections of the American Society of Mechanical Engineers for the year 1918, through whose leadership the full value of membership in a great national organization is being realized to a greater extent than ever before. In this connection it is appropriate to refer to the affiliated society of the A.S.M.E., the Providence Engineering Society, and to publish a portrait of its president.

This society was organized in 1894 under the name of the Rhode Island Association of Mechanicians. The next year the name was changed to the Providence Association of Mechanical Engineers, under which name it continued until 1915, when it was reorganized to include all branches of engineering and became the Providence Engineering Society.

In 1911, when the Providence Engineering Society became affiliated with our own organization, it was known as the Providence Association of Mechanical Engineers. Its activities then pertained almost exclusively to the field of mechanical engineering, which is so strongly represented in the industries of Providence. Although it has remained in every way an independent organization in distinction from that of the several Sections of our Society, which are integral parts of the parent body, the affiliation represents a mutual interest between the organizations of a real and vital character. One pleasant feature of the affiliation has been the joint dinners held with officers of the A.S.M.E. as guests of the Providence society.

It is expected that a large number of the members of the Providence Engineering Society will attend the Worcester meeting during the first week of June, and the Providence organization has generously contributed to the success of this meeting by arranging for three professional papers from its own membership.

Robert Winthrop Adams, the president of the Providence Engineering Society, is a graduate of Worcester Polytechnic Institute in the electrical engineering course, and has been connected with the B. F. Sturtevant Company, Hyde Park, Mass., the D & W Fuse Co., Providence, R. I., the Pittsfield Works of the General Electric Company, and is now manager of the Providence office of the General Electric Company. When with the D & W Fuse Co. he was engaged in research and development work on enclosed fuses for three years, and during this period was awarded the degree of Electrical Engineer by the Worcester Polytechnic Institute in recognition of original research work.

Mr. Adams is the inventor of the transmission-line calculator

R. W. ADAMS, PRESIDENT OF THE PROVIDENCE ENGINEERING SOCIETY

for the rapid calculation of line drop in alternating-current circuits, and has been a contributor to various technical journals. As a member of the Rhode Island Council of Defense since its formation, he has had charge of all engineering matters in connection with preparedness and war work, including a complete war census of Rhode Island engineers.

Section Meetings

BIRMINGHAM

April 25. After a business meeting an interesting address was given by James W. Moore, of the American Cast Iron Pipe Company, on The Producer-Gas Plant of The American Cast Iron Pipe Company, and it was pointed out how coke braize was used instead of coal. Comparisons were made between coke-braize gas and gas from Pocahontas coal in a double-zone producer, and operating conditions and costs were traced.

W. L. ROUECHE,
Section Secretary.

BOSTON

April 30. A joint meeting of the Boston Society of Civil Engineers, The American Society of Mechanical Engineers, and the American Institute of Electrical Engineers was held at the City Club. Over 400 engineers sat down to supper.

Mr. W. H. Blood, Jr., of the American International Shipbuilding Corporation, delivered a very interesting illustrated address on Hog Island, the greatest shipyard in the world. By word and picture he described the wonderful progress which was made in six months in the transformation of a barren waste into a seething hive of industry, embodying an area of over 900 acres with a working force averaging over 26,000 persons.

Mr. Alfred D. Flinn, Secretary of the Engineering Council, gave a talk on the progress and aims of the Engineering Council.

Short addresses on subjects of the day were given by Major-General H. F. Hodges, in command of Camp Devens, at Ayer, Mass., and Mayor Andrew J. Peters of Boston. Motion pictures were shown illustrating the adaptability of a new rudder which has been perfected by Mr. H. O. Westendarp of the General Electric Company. By skilful manipulation the pilot can by means of this new type of rudder make a vessel go forward or backward, or circle right or left without changing the direction or speed of his engine. This should prove a wonderful aid in combating the U-boat.

W. C. STARKWEATHER,
Section Secretary.

BUFFALO

April 24. An instructive lecture on Ball Bearings, Their Designs, Manufacture and Application, was given by S. W. Gurney, of the Gurney Ball Bearing Co., Jamestown, N. Y., who is a recognized authority on this subject.

May 1. The meeting was of a strictly business nature and included the reports of officers and committees and the election of officers for the Engineering Society of Buffalo for the coming year. The following were elected: George B. Bassett, president; H. P. Parrock, vice-president; E. B. Neil, secretary, and W. M. Dollar, treasurer. Messrs. F. A. Lidbury and David W. Sowers were elected directors.

E. B. NEIL,
Section Secretary.

CHICAGO

April 22. At a joint meeting of the Chicago A.S.M.E. and A.I.E.E. Sections and the mechanical and electrical sections of the Western Society of Engineers, C. F. Kettering, Mem.Am. Soc.M.E., delivered a talk on The Automobile Power Plant.

May 24. Mr. John E. Ericson, Mem.Am.Soc.M.E., and City Engineer, delivered a lecture on The Mayfair Pumping Station.

ARTHUR L. RICE,
Section Secretary.

CONNECTICUT SECTION

Bridgeport Branch

April 24. Motion pictures, a good dinner and some fine speeches on matters of interest to engineers and factory men were the features of the spring meeting, held at the Stratfield Hotel. Members and friends from all parts of Connecticut were present at this meeting, 211 being the total number attending the evening gathering.

Committee and "get-acquainted" meetings were held during the afternoon. Ten reels of motion pictures, most of them being illustrative of factory work, were shown, and later dinner was served.

The opening address of the meeting was made by Henry B. Sargent. Secretary Rice, the second speaker, told of some of the work of the Society. Judge John S. Pullman gave a patriotic address, telling of the work of the draft and how men could best serve their country by their jobs. Clinton E. Woods, of the Woods-Keller Company, spoke on Factory Accounting as a Bill for Controlling Production. Harry E. Harris, Chairman of the Joint Gage Committee of the A.S.M.E. and S.A.E., discussed Facilitation of War Production by Practicable Manufacturing Allowances. He was followed by William R. Webster, vice-president of the Bridgeport Brass Company, whose subject was Intelligence, Specifications and Inspection as a Factor in Production Increases. Allen B. Lincoln, associate director of the U. S. Department of Labor of the Connecticut State Council of Defense, told of the work of his department.

E. L. FLETCHER,
Branch Secretary.

Hartford Branch

May 13. After a brief business meeting, at which the following officers for the year 1918-19 were elected: Chas. S. Blake, chairman, Frank E. Howard, vice-chairman, and M. D. Church, secretary-treasurer, an interesting talk on submarines was given by P. B. Brill, general manager, Lake Torpedo Boat Company. He cited the progress of battleship design, giving a general idea of the various types of vessels and the arrangement of their guns, and described the various protective devices from torpedoes. A description of the different types of submarines from the earliest designs down to the most advanced stage of the art was given.

Private Wm. J. O'Neill, of the 101st Machine Gun Battalion, who has just returned from the fighting line in France, gave a short talk on the importance of the people at home supporting the soldier in the trenches. Some of his own experiences in the trenches were touched on.

S. F. JETER,
Branch Secretary.

New Haven Branch

May 10. A business meeting preceded the regular meeting of the Branch at which the following officers were elected for the year 1918-19: E. H. Lockwood, J. Arnold Norcross, F. L. Mackintosh, Edwin Pugsley, A. C. Jewett and S. H. Barnum, 2d.

Professor Breckenridge then reported on the plan of the Fuel Administration to inspect all power plants of the country. In conformity with this plan a state fuel engineer will be appointed for Connecticut. It was then voted that the Executive Committee of the Connecticut Section coöperate with the proposed plan by nominating a suitable candidate for this position, reporting same to the Fuel Administrator.

An informal paper was given on the Development of the Repeating Rifle by Edwin Pugsley, Jun.Am.Soc.M.E. The talk was illustrated by a striking display of rifles showing the steps of the development leading up to the repeating rifle and including the Browning gun.

E. H. LOCKWOOD,
Branch Secretary.

CINCINNATI

May 11. In a very inspiring address Secretary Rice presented the various activities of the A.S.M.E. He pointed out how the opportunity and ability of its members to serve in numerous ways has enabled the Society to be of substantial service to the Nation in solving problems such as those relating to the conservation of coal, wages of employees, the draft law, nitrate plants, and the activities of the Research Council. The policy of helping to win the war is exemplified in the appointing and organizing of committees, the presentation of papers and the use of the Society's rooms as recruiting offices. The Roll of Honor now constitutes 15 per cent of the membership. The whole sentiment expressed in the dedication of the Engineers' Club House at Dayton, Ohio, represents the spirit of the times in which engineers are realizing their duties toward the communities in which they live and are acquiring a feeling of civic responsibility. Such a sentiment, created through the Sections, will enhance the status and solidarity of the engineering profession. Mr. Rice suggested that the Sections organize committees on pavements, water, etc., and sub-committees of chemical, civil, electrical and other branches of engineering.

At present there is an opportunity to assist in the training of mechanics for the service. One million men are needed and at present there is provision for only ninety thousand by the first of September. Each member of the Section was then called upon to pledge his support in assisting in the war education work in Cincinnati.

Mr. Fred A. Geier, Assoc.Am.Soc.M.E., made a short address in which he emphasized the importance of the problems with which the Council is confronted at this time, and the policy in dealing with matters of national interest.

JOHN T. FAIG,
Section Secretary.

DETROIT

May 3. The Detroit A.S.M.E. Section held its Annual Meeting in conjunction with the Detroit Engineering Society at the Board of Commerce Building.

After the dinner, the election of the Executive Committee for 1918-19 was held and the following officers were elected: E. C. Fisher, E. J. Frost, F. H. Mason, E. J. Burdick and J. C. McCabe.

Mr. Robert H. Kuss, Mem.Am.Soc.M.E., and Consulting Engineer of Chicago, presented a very interesting paper on Coal Con-

servation, discussing that part of this broad subject embraced within the handling at the power house, furnace construction, firing methods and control.

Dean M. E. Cooley and Secretary F. H. Mason presented the following set of resolutions:

WHEREAS, The demands of the country for men and means to fight the war have resulted in a deficiency of skilled workers in the trades and professions; and

WHEREAS, The women of this country could with a short period of training fit themselves to fill these positions, as women have done in other countries at war; and

WHEREAS, Among the things which women could do advantageously are *drafting* and *tracing, inspection and testing of materials, both physically and chemically*: therefore, be it

RESOLVED, That the universities, colleges and technical schools throughout the land be asked to consider the question of meeting this demand by providing special courses of instruction open to women students qualified to pursue such courses; and further, be it

RESOLVED, That employers who could use such skilled help exert their influence with their universities, colleges and technical schools, and coöperate with them in developing and making available a great body of intelligent and adaptable women who are as eager and willing to serve their country as their brothers;

THEREBY bringing about not only increased effectiveness in fighting the war, but also a greater mutual respect and saner relationship of our men and women.

These resolutions were unanimously adopted, and it is hoped all members of the Society will give wide publicity to them in order that some definite results may be promptly obtained in the training of women to fill subordinate positions in the drafting room and inspection departments of the industries.

F. H. MASON,
Section Secretary.

INDIANAPOLIS

May 10. The officers elected for the ensuing year are as follows: L. W. Wallace, chairman; W. A. Hanley, vice-chairman; B. G. Mering, treasurer; F. C. Wagner and G. A. Young.

Secretary Rice gave an address on the relation of the National Society to the Section, the relation of the engineer to the war, and ways in which he can assist the National Fuel Administrator and his city or community.

The subject Heat Losses in Uncovered Steam Pipes was also discussed.

W. A. HANLEY,
Section Secretary.

MILWAUKEE

March 13. Under the auspices of the A.I.E.E. Section, Professor Cyril M. Jansky, of the University of Wisconsin, delivered an interesting lecture on Science in War, bringing out the part that science plays in the affairs of men. A very interesting film was shown entitled The King of the Rails, which pictured the electrical division of the C. M. & St. Paul R.R.

April 10. At a meeting held under the auspices of the American Society of Refrigerating Engineers, Mr. Charles L. Fortier, chief engineer of the Johnson Service Company, gave an illustrated talk on Automatic Control Apparatus for Temperature Control in general and also as applied to the refrigerating industry.

May 8. A lecture on The White Coals of Wisconsin, in which a very complete description of the Wissota Dam was given, was delivered by N. J. Whelan, industrial commissioner of the Wisconsin-Minnesota Light & Power Co., and V. S. Hillyer, construction engineer with the same company.

FRED H. DORNER,
Section Secretary.

NEW ORLEANS

May 13. Under the auspices of the Louisiana Engineering Society and the A.S.M.E. Section a meeting was held at which the Honorable T. F. Carlisle, British Consul, delivered a very interesting address on Britain and the War the Last Twelve Months.

Secretary Rice gave a talk on the War Activities of the A.S.M.E. and the Need of Coöperation Among Engineering Societies.

A business meeting followed at which the following officers were elected for 1918-19: H. L. Hutson, chairman; E. W. Carr, secretary; R. T. Burwell, W. B. Moses and J. S. Barelli.

H. L. HUTSON,
Section Secretary.

NEW YORK

May 21. Labor Turnover was the subject of the meeting and was discussed by the following speakers representing makers of ships, aeroplanes, ordnance and machine tools: L. D. Burlingame, industrial superintendent, Brown & Sharpe Mfg. Co., John Calder, Aeromarine Plane & Motor Co., Capt. Boyd Fisher, Ordnance Department, U. S. A., Dudley Kennedy, American International Shipbuilding Corp., H. E. Miles, Council National Defense, J. J. Pearson, British War Office, H. F. J. Porter, consulting industrial engineer, and Orrin W. Sanderson, director of labor, B. F. Goodrich Company.

Opportunity was given to participate in short three-minute speeches and among the discussers were the following: F. H. Colvin, Editor *American Machinist;* L. P. Alford, Editor *Industrial Management,* and Eric Oberg, Editor *Machinery.*

A more detailed account of the meeting will appear in the July JOURNAL.

W. HERMAN GREUL,
Section Secretary.

ONTARIO

April 18. A very interesting paper on the Heat Treatment of Low-Carbon Steels was presented by W. M. Wilkie of the Steel Department of the Imperial Munitions Board. The discussion that followed the paper bore principally on the troubles encountered by the producers and users of shell steel. Among the engineers present were a number of those connected with local munitions plants, and their remarks based on actual experiences and the solution of various troubles under war time conditions were very interesting.

CHESTER B. HAMILTON, JR.,
Section Secretary.

PHILADELPHIA

April 23. The Philadelphia Section entertained the Council of the National Society at a dinner meeting at the Adelphia Hotel at which over one hundred members of the Section were present.

During the preceding day, the Council had visited and inspected Cramp's Ship Yard, and also the Hog Island plant of The American International Shipbuilding Corporation.

Mr. Lewis F. Moody presided at the meeting. He introduced as toastmaster D. Robt. Yarnall, chairman of the National Committee on Sections. The Council was given a greeting from Philadelphia by W. S. Catell. President Chas. T. Main responded in behalf of the Council. Following President Main, Messrs. James Hartness, C. C. Thomas, S. M. Vauclain and W. C. L. Eglin each gave a short talk.

J. P. MUDD,
Section Secretary.

PROVIDENCE

April 24. Under the auspices of the Municipal Engineering Section an illustrated lecture was delivered by Frank E. Winsor, chief engineer of the Providence Water Supply Board on The Development of the New Providence Water Supply.

April 25. A business meeting of the Efficiency Section was held, at which new officers were elected.

April 30. At a joint meeting of the Rhode Island Section of the American Chemical Society and the Providence Engineering Society, Lieut.-Col. Allerton S. Cushman, Ord. Dept. U.S.N.A., delivered an illustrated lecture on The Manufacture of Military Primers. Mr. H. Anthony Dyer also delivered a short address in connection with the unfurling of the service flag of the society.

May 8. Prof. L. B. McMillan, of the H. W. Johns-Manville Co., gave an address on Thermal Insulation at the Power Section meeting.

May 14. At the Machine Shop Section meeting a discussion on Experimental Investigation of Machine Tools and Its Effect on Machine Tool Design was led by Professor James A. Hall, of Brown University, a number of representatives from various machine-tool companies contributing toward the discussion.

JAMES A. HALL,
Correspondent.

PERSONALS

IN these columns are inserted items concerning members of the Society and their professional activities. Members are always interested in the doings of their fellow-members, and the Society welcomes notes from members and concerning members for insertion in this section. All communications of personal notes should be addressed to the Secretary, and items should be received by June 15 in order to appear in the July issue.

CHANGES OF POSITION

ALBERT H. HUDSON, formerly general purchasing agent of the Wright-Martin Aircraft Corporation, New York, has assumed the duties of purchasing agent of the American International Steel Corporation, New York.

JOHN D. BOWLES has left the employ of the Springfield Gas and Electric Company and Springfield Traction Company, to become associated with the Douglas Company, of Cedar Rapids, Iowa, in the capacity of general mechanical superintendent.

WILLIAM G. EDMONDSON has resigned from the Illinois Zinc Company, Peru, Ill., to reënter the service of the Interstate Commerce Commission, as mechanical engineer, with headquarters at Washington, D. C.

FRANCIS L. LINDEMUTH, formerly affiliated with the H. Koppers Company, Pittsburgh, Pa., has become associated with Perin and Marshall, consulting engineers of New York.

CHARLES E. BURGOON has severed his connection with the Sandusky Cement Company, Cleveland, Ohio, and has accepted a position in the engineering department of the Air Nitrates Corporation, New York.

JACOB H. WALLACE, formerly engineer with the Western Chemical Manufacturing Company, Denver, Colo., has become associated with the United Verde Copper Company, Clarkdale, Ariz.

A. E. HOWARD, formerly production engineer for Ingersoll-Rand Company, Phillipsburg, N. J., has accepted a similar position with Manning, Maxwell and Moore, and will be located at the Ashcroft plant, Bridgeport, Conn., for the next two months.

CHARLES D. REEVE has resigned his position as vice-president and factory manager of the Grand Rapids Brass Company, Grand Rapids, Mich. He has bought a controlling interest in the American Brass Novelty Company, of Grand Haven, Mich., and holds the position of president and general manager with the company.

JOHN CHUCAN has left the employ of the International Harvester Corporation, Tractor Works, Chicago, Ill., to assume the position of mechanical engineer with the Goodwin Car and Manufacturing Company, Inc., of the same city.

JONATHAN A. WILSON, until recently traveling engineer for the Babcock and Wilcox Company, Bayonne, N. J., has accepted the position of purchasing agent for the Todd Shipyards Corporation, of New York.

E. R. KENNER, formerly with the Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa., is now with the Air Nitrates Corporation, Muscle Shoals, Ala.

A. C. V. MALM, formerly president and general manager of the Malm Machine Company, Dayton, Ohio, has assumed similar duties with the Malm Engineering Company, of Philadelphia, Pa., a newly formed company. In addition to consulting engineering, the new company has leased the rights to manufacture the Malm rotary punch presses for rubber and metal punching, now patented, belonging to the Malm Machine Company.

JOHN J. EASON has accepted the position of works manager with the United States and Cuban Allied Works Engineering Corporation, operating the Havana Iron Works and the Havana Dry Dock Company, in Cuba. Mr. Eason was formerly connected with the Havana Marine Railways, Inc., Havana, Cuba, in the capacity of general superintendent.

GEORGE E. BARRETT, until recently affiliated with the Sprague Electric Works, Bloomfield, N. J., has assumed the duties of inspector of naval construction, Bureau of Construction and Repair, Washington, D. C.

OTTO G. JENNER has severed his connection as industrial engineer with the Inland Steel Company, Chicago Heights, Ill., and has accepted the position of superintendent with the Wilson and Bennett Manufacturing Company, Chicago, Ill.

JOHN H. NELSON has resigned from the Bureau of Standards, Washington, D. C., to become research engineer with the Wyman-Gordon Company, Worcester, Mass.

FREDERICK G. KENYON, formerly with the engineering department of Remington Arms Union Metallic Cartridge Company, Bridgeport, Conn., has become associated with the American Can Company, Liberty Ordnance Plant, of the same city, as chief draftsman.

ROBERT W. ELLINGHAM has resigned from The Bilton Machine Tool Company, Bridgeport, Conn., to enter the employ of the Heald Machine Company, as works manager.

HARRY G. BALDWIN has resigned his position with the S K F Bearing Company, Hartford, Conn., to accept the position of assistant general manager with the Henry G. Thompson and Son Company.

ANNOUNCEMENTS

GEORGE F. SWAIN, of the Massachusetts Institute of Technology staff, has returned to the Institute from the western part of the country after having been honored twice by the University of California on the occasion of its semi-centennial, which conferred on him the degree of LL.D. and also accorded him the distinction of being the first engineer to deliver before the University one of the Hitchcock lectures, which are supported by an endowment of $10,000. For his subject, Professor Swain selected Some General Principles and Disputed Points in the Valuation of Public Utility Corporations.

JAMES A. BEAUBIEN has assumed the duties of general manager and mechanical engineer with the Weber Subterranean Pump Company, of New York.

ERNEST B. BISHOP has been transferred from the Ilion Works to the Smith Premier Works of the Remington Typewriter Company, Syracuse, N. Y.

WILLIAM R. WILSON, until recently secretary of the Alberger Pump and Condenser Company, New York, has been elected vice-president, and RICHARD C. WILLIAMS has been elected secretary of the company.

SCHUYLER S. WHEELER, of Ampere, N. J., is in France and later will go to Great Britain to explain the system that he has successfully used in his factories by means of which persons physically handicapped may become self-supporting workers. He was invited by Eugene Brieux, who is in charge of this sort of work done by the French Government.

WARREN E. MURRAY, consulting engineer, announces the establishment of general engineering offices at San Francisco, Cal. He was, until recently, with the Western Sugar Refining Company, of the same city, as refinery manager.

HAL R. STAFFORD, mechanical engineer of the Economy Devices Corporation, New York, is now chief engineer of the Franklin Railway Supply Company, Inc., a consolidation of the Economy Devices Corporation and the Franklin Railway Supply Company.

RALPH G. MACY, formerly in the Army, and with the Air Reduction Company prior to that, has resigned his commission and is now with the New York Steam Company, New York.

The honorary degree of doctor of engineering has been conferred upon ALEXANDER C. HUMPHREYS, president of Stevens Institute of Technology, by the Rensselaer Polytechnic Institute.

RUSSELL G. CLARK, general draftsman of the American Thread Company, formerly at Willimantic, Conn., is now located at the head office of the company, in New York.

HUBERT C. VERHEY, who joined the technical department of the Emergency Fleet Corporation at Washington, D. C., in the capacity of chief draftsman is now at the head of the marine Diesel engine department.

R. S. BRUNNER has become identified with the Hamilton-Otto Coke Company, of Hamilton, Ohio.

F. G. PEASE has become associated with the National Research Council, Washington, D. C., as chief draftsman of the Engineering Section.

DUGALD C. JACKSON, in charge of the Department of Electrical Engineering at Massachusetts Institute of Technology, Cambridge, Mass., has been called into active service. Last December Professor Jackson took the formal oath and now has been ordered "over there." His commission is that of Major in the Engineer Reserve Corps.

JOHN T. FAIG, for 12 years professor of mechanical engineering, University of Cincinnati, has been appointed president of the Ohio Mechanics Institute. Professor Faig will give special attention to training students in the operation and construction of internal-combustion engines.

MARCUS T. LOTHROP has been appointed assistant factory manager of the Timken Roller Bearing Company, Canton, Ohio. He has been metallurgist and has had charge of the steel and tube department of the company for the past seven years.

CAPTAIN FREDERICK H. MOODY, who upon being wounded in France was evacuated to England, was temporarily loaned to the Ministry of Munitions for inspectional and expediting work on mechanical plants for the Air Board, is still acting as an Air Board officer.

APPOINTMENTS

ALLEN E. OSTRANDER has been appointed general mechanical engineer of the American Car and Foundry Company, New York. He was previously connected with the company in the capacity of mechanical engineer.

O. S. MAPLE, formerly purchasing assistant of the U. S. Shipping Board, Emergency Fleet Corporation, at Washington, D. C., has recently been appointed assistant purchasing officer.

HAROLD G. KNIESE has accepted an appointment as mechanical draftsman and designer in the Nitrate Division, War Ordnance Department, Washington, D. C.

WILLIAM D. HALSEY has been appointed mechanical engineer with the National Advisory Committee for Aeronautics at Washington, D. C. He will continue his late afternoon and evening classes at the George Washington University, Washington, D. C., as assistant professor of mechanical engineering.

AUTHORS OF PAPERS, ETC.

STERLING H. BUNNELL has contributed a brief article on Commercial Relations of Allies with Russia, to the May 16 issue of *The Iron Age*.

HARRISON R. CADY is the author of an article entitled Electrification of Pumping Stations Saves Coal and Money which appears in the May 9 number of *Engineering News-Record*.

NECROLOGY

REAR ADMIRAL JOHN D. FORD

John D. Ford, Rear Admiral (retired) in the United States Navy, died at his home in Baltimore on April 8, 1918.

Admiral Ford was born on May 19, 1840, in Maryland and was educated in the public schools of Baltimore. He was graduated from the Maryland Institute School of Design in June 1861, receiving the Peabody Prize. The following year he was graduated from the Potts School of Mechanical Engineering and immediately entered the United States Navy as third assistant engineer. Early in 1864 he was made second assistant engineer and two years later became first assistant engineer. On December 27, 1890, he was made chief engineer.

JOHN D. FORD

During the Civil War Admiral Ford took part in the recapture of Baton Rouge, La., in March 1863, and in the Battle of Mobile Bay, 1864, and was on the *Arizona* when it was destroyed by fire off Poverty Point in the Mississippi River in 1865. He was wrecked in the *Sacramento* on the Coromandel coast of India in 1867.

In 1884 he was put on detached service for the purpose of establishing the Baltimore Manual Training School. From 1894 to 1896 he was connected with the Maryland Agricultural and Mechanical College. He was next assigned to the U. S. S. *Brooklyn*, with the relative rank of commodore, and in 1898 to the U. S. S. *Baltimore* (flagship), later becoming fleet engineer of the Pacific Station. He joined the Asiatic fleet and took part in actions of April 30, May 1 and August 13, 1898, and in the destruction of the Spanish fleet off Cavite, the destruction of the batteries at Cavite and at Sangley Point, the capture of the forts at Corregidor and the capture of Manila. On May 19, 1905, he retired from the service as Rear Admiral.

Admiral Ford was a member of the Associated Veterans of Farragut's Fleet, the Loyal Legion, the Society of Manila Bay, and of the American Society of Naval Engineers. He became a member of our Society in 1884.

HENRY ARTHUR BAYFIELD

Henry A. Bayfield was born in Charlottetown, Prince Edward Island, Canada, on June 19, 1873. He was graduated from McGill University, Montreal, in 1896, with the degree of Bachelor of Applied Science, having taken the mechanical-engineering course.

The first two years after his graduation he spent at the shops of the Intercolonial Railway, Moncton, N. B., as machinist and junior mechanical draftsman, and in testing locomotives on the road. He was also a year in the Great Northern Railway shops at St. Paul, Minn., where he was draftsman in charge of the office; later he was made superintendent of the company's shops at West Superior, Wis. For a short period he was with the Dar-

danelles Mining Company, Sandon, B. C., overhauling and operating their plant. From 1899 to 1900 he was connected with the Albion Iron Works and Victoria Machinery Depot, Victoria, B. C., as a designer of small marine engines, boilers, etc., leaving this firm to become senior designer on dredging and hoisting machinery, air compressors, shop appliances, etc., with the James Cooper Mfg. Co., Montreal. In 1901 Mr. Bayfield was appointed mechanical superintendent in charge of dredging fleet, shops and shipyard for the Harbor Commissioners of Montreal. About three years later he entered on private practice in Vancouver, B. C., and with the exception of an interval with the British Columbia General Contract Company, continued in private practice until 1909, when he entered the service of the Department of Public Works of Canada, being appointed superintendent of dredging for British Columbia. In December 1912 Mr. Bayfield was made chief engineer in charge of all estimating and designing of the Vancouver Machinery Depot Company, where he remained until 1913, when he was again called upon by the Dominion Government to design a self-propelling hydraulic dredge. In 1914 he returned to private practice at Vancouver, B. C., engaging principally in consulting work in connection with dredging and marine matters, but was called in 1915 to the Department of Railways and Canals of Canada to take the position of mechanical engineer in charge of all mechanical and marine work at Port Nelson, Manitoba. Late in the same year Mr. Bayfield became chief engineer with Norton, Griffiths & Co., Ltd., St. John, N. B., in connection with the harbor-improvement contract. In 1916 he was called on by the British Ministry of Munitions of War to take charge of the Enfield rifle production at the Winchester Repeating Arms Company, New Haven, Conn., where he remained until the summer of 1917, when he was appointed engineer in charge of the Ogden Point assembly plant of the Imperial Munitions Board, Victoria, B. C. He held this position at the time of his death, February 12, 1918.

Mr. Bayfield was a member of the Institution of Mechanical Engineers (Great Britain) and an associate member of the Canadian Society of Civil Engineers. He became a member of our Society in 1913.

ROBERT ELLSWORTH JACKSON

Robert E. Jackson was born in Matteawan, N. Y., on August 24, 1888. He was educated in the public schools of Garfield, N. J.

He served his apprenticeship with the Dutchess Tool Works, Fishkill Landing, N. Y., and there learned the machinist's trade. The year of 1910 he spent with the Coldwell Wilcox Company, Newburgh, N. Y., as machinist. He then worked in the same capacity for about six months with the Fiat Automobile Company, Poughkeepsie, N. Y. Upon leaving this company he became associated with P. H. Gill & Sons, Brooklyn, N. Y., as machinist. In April 1911 he entered the employ of the Edison Laboratory, West Orange, N. J., as foreman of the machine department. He was later made superintendent and held this position at the time of his death.

Mr. Jackson became a junior member of the Society in 1917. He died at West Orange, N. J., on April 5, 1918.

ERNEST AINSWORTH MOORE

Ernest A. Moore was born in Victoria, Australia, on October 14, 1879. He was educated in Melbourne, Australia, and later received special instruction in work of a mechanical nature from tutors.

While in Australia he was employed by Knox, Schlapp & Co., who represented the Allis-Chalmers Company, in the capacity of private secretary to Mr. William Knox. In 1904 Mr. Moore decided to come to the United States and in August of that year became draftsman with the Filer & Stowell Co., Milwaukee. Two years later he became connected with the Allis-Chalmers Company, working first in the gas-engine department, and later as assistant engineer. In 1908 he became chief engineer of the Bates Machine Company, Joliet, Ill., having full charge of all technical and later all commercial engineering work; he designed, built and supervised a great amount of special machinery and while with this company obtained his experience in work of a consulting and legal technical nature.

Mr. Moore left the Bates Machine Company in 1913 to take the position of resident manager in Chicago for the A. M. Byers Company, Pittsburgh, manufacturers of wrought-iron pipe. About May 1914 he left Chicago for Detroit, planning to develop there a new business for the production of a new machine making paper containers. This machine was first designed by him in 1911 and was gradually perfected, until in 1914 the Moore Container Company was organized in Detroit with Mr. Moore as president. Plans were practically completed for the manufacture of the machine when his health failed and he was forced to give up his work completely and leave for the West in an effort to regain his strength. He died very suddenly in Phoenix, Ariz., on February 15, 1918.

Mr. Moore became a member of the Society in 1913.

WILLIAM PRESCOTT SARGENT

William P. Sargent was born in Stoneham, Mass., on September 9, 1878, and received his early education in the public schools of that city.

He was first employed in 1896 by Prentice Brothers, Worcester, Mass., manufacturers of machine tools, where he had charge of the stock room. His spare time he devoted to learning machine operation and machine fitting. His next position was with the Draper Machine Tool Company as draftsman. For a short while thereafter he was connected with the Lodge & Shipley Machine Tool Company, Cincinnati, as a designer of special machinery. In 1903 he was made special engineer for the Niles Tool Works, Hamilton, Ohio, where his work dealt with chemical and metallurgical research problems. He returned to the Pratt & Whitney Co. as assistant construction engineer in the design of the machine shop, foundry and power plant which were being erected. He was next made engineer in direct charge of the design and construction of the machine and forge shop of the Niles Tool Works. About 1907 Mr. Sargent became associated with the Barber-Colman Company, Rockford, Ill., as engineer to design and develop automatic textile machinery. From 1909 to 1915 he was engaged in the design and development of automatic machinery for handling periodicals, papers and paste, and in the design and construction for the Bureau of Chemistry of several graphic machines for recording impacts and stresses. He was associated also with the Curtis Publishing Company, Philadelphia, where he was interested in the reduction of labor costs in the mechanical processes involved in the publication of 5,000,000 magazine copies a month. During the years of 1915 and 1916 Mr. Sargent devoted his time to coördinating the facilities of more than twelve small shops whose production singly of gages, tools and ordnance parts would not have been appreciable. Recently Mr. Sargent was engaged in the construction of gages and interested in other work for the Frankford Arsenal.

Mr. Sargent became a member of the Society in 1909. He died on April 10, 1918.

WILLIAM WARREN SMITH

William W. Smith was born in Toronto, Canada, on September 9, 1876. He was educated in the public schools of Michigan and in Michigan Agricultural College, taking the mechanical-engineering course. Later he attended Purdue University, where he took special work in mechanics.

He obtained his shop experience with the Welded Steel Barrel Company, Detroit, Mich., where for about a year and a half he was draftsman and inspector. He spent two years with the American Car and Foundry Company, Detroit and St. Louis, as draftsman, estimator and finally as chief draftsman. His next position was with the Standard Steel Car Company, Pittsburgh, as assistant construction engineer, where he remained for about a year, leaving to become assistant manager with the Mexican Car and Foundry Company, Mexico City. He remained in Mexico, transferring his business connections to the National Iron and Steel Works as superintendent and mechanical engineer in charge of design for miscellaneous machine and structural-steel work. About 1916 Mr. Smith became associated with Dodwell & Co., New York, as foreign representative with Behn Brothers, San Juan, Porto Rico. In February of this year he joined the sales force of the Allis-Chalmers Manufacturing Company, expecting later to be transferred to sales work in South America, with which country he was especially familiar.

Mr. Smith became a member of the Society in 1909. He died in Milwaukee, Wis., on April 1, 1918.

ROLL OF HONOR

ALEXANDER, LUDWELL B., First Lieutenant, Aero Section, Signal Officers' Reserve Corps, School of Military Aeronautics, Massachusetts Institute of Technology.
ANTOSCH, WALTER, Ensign, United States Naval Auxiliary Reserve.
BALLOU, J. LADD, Sergeant, Co. C, 342d Inf., Camp Grant, Ill.
BARKER, EARNEST S., First Lieutenant, Headquarters Co., 48th Infantry, Camp Stuart, Newport News, Va.
BARRON, ALEXANDER F., Private, Co. F, 305th Engineers, Camp Lee, Va.
BARRY, JOHN L., JR., Ensign, Engineering, U. S. Naval Auxiliary Reserve.
BECHTEL, JOHN A., Captain, Co. F, 108th Supply Train, 33d Division, U. S. Expeditionary Forces, France.
BOYER, GEORGE H., First Lieutenant, Ordnance Training Camp, Camp Hancock, Augusta, Ga.
BRIGGS, LESTER G., U. S. Navy Aviation.
BUCK, J. E., Ensign, U. S. Naval Reserve Force.
CARPENTER, F. S., First Lieutenant, Signal Corps, U. S. Army.
CLARKE, LEON L., Captain, Engineer Officers' Reserve Corps, American Expeditionary Forces, France.
DAYTON, BIRGE S., Private, Co. C, 6th Regiment, U. S. Engineers, American Expeditionary Forces, France.
DICKSON, CHARLES H., First Lieutenant, Ordnance Officers' Reserve Corps.
DOUGLAS, MORRIS D., First Lieutenant, Ordnance Officers' Reserve Corps, Inspection Division, Ordnance Dept.
EKSTRAND, CHARLES E., Lieutenant (Junior Grade), U. S. Naval Reserve Force.
GIANELLONI, VIVIAN J., Lieutenant, Coast Artillery Reserve Corps, Co. B, 53d, A. T. C. A. C., Oakland, Cal.
GOLDSMITH, CLARENCE, Major, Construction Division, Quartermaster's Corps, U. S. Army.
HAMILTON, W. B., Captain, Ordnance Officers' Reserve Corps, Division of American Ordnance Base Depot in France.
HOSMER, FRED E., Lieutenant, Assistant Engineer Officer, Headquarters Staff, Aviation Section, Ebberts Field, Lonoke, Ark.
JACKSON, DUGALD C., Major, Engineer Officers' Reserve Corps, American Expeditionary Forces, France.
JACKSON, E. R., First Lieutenant, Ordnance Officers' Reserve Corps, Inspection Division, Ordnance Dept., U. S. A.
JACKSON, WILLIAM B., Major, Quartermaster's Corps, U. S. A., Officer in Charge of Utilities, Camp Merritt, N. J.
LYNE, L. F., First Lieutenant, Ordnance Officers' Reserve Corps, Inspection Division, Ordnance Department, U. S. Army.
MCKAIG, W. W., Ensign, Bureau of Construction and Repair (Aviation), Navy Dept.
MCNALLY, EDWIN M., Ensign, U. S. Naval Reserve Force, Bureau of Steam Engineering, Navy Department.
MARROW, GEORGE P., Major, United States Army.
MERRILL, S. CLIFFORD, Second Lieutenant, Ordnance Officers' Reserve Corps, Inspection Division, Ordnance Department, U. S. Army.
MORSE, WALTER R., Captain, N. A., 301st Engineers, Camp Devens, Mass.
MUNYAN, EARL A., Lieutenant (Junior Grade), U. S. Naval Reserve Force, Navy Department, Bureau of Ordnance.
NORTHCROFT, JAMES F. S., Officers' Training Camp, British Army, England.
PLANK, WILLIAM J., Cadet, Aviation Section, Signal Enlisted Reserve Corps, School of Military Aeronautics, Austin, Tex.
ROBECHEK, B., 21st Co., Coast Artillery Corps, Ft. Preble, Me.
ROBERTS, CHAPIN, Ensign, U. S. Naval Reserve Force, U. S. S. *Hauck*.
ROSE, DAVID, Private, Co. C, Second Provisional Ordnance Bureau, American Expeditionary Forces, France.
SAWYER, WILFRED D., Private, Camp Funston, Tex.
SCHALLER, ALWIN L., Captain, Ordnance Department, N. A., Aberdeen Proving Ground, Md.
SEATON, EDWARD W., Private, Ordnance Corps, Detachment A, Gunpowder Reservation, Barracks 2, Edgewood, Md.
SEWARD, HERBERT L., Lieutenant (Senior Grade), U. S. Naval Reserve Force, Navy Steam Engineering School, N. Y.
SMOCK, HAROLD E., U. S. Naval Reserve Force, stationed at Dayton, Ohio.
SOUTH, FURMAN, JR., Lieutenant, Ordnance Officers' Reserve Corps, Ordnance Department, U. S. Army.
TAYLOR, PAUL H., First Lieutenant, Ordnance Officers' Reserve Corps, 26th Division, Ordnance Mobile Repair Shops, American Expeditionary Forces, France.
TAYLOR, STEVENSON, Lieutenant-Colonel, U. S. Naval Reserve Force.
THURSTON, EDWARD D., JR., Lieutenant (Junior Grade), U. S. Naval Reserve Force, U. S. Navy Gas-Engine School, Columbia University, N. Y.
WALSH, EDWARD T., Major, Ordnance Officers' Reserve Corps, Inspection Division, Ordnance Department.
WELLING, LINDSAY H., Sergeant, 117 Mobile Ordnance Repair Shop, American Expeditionary Forces, France.
WETHERILL, WILLIAM C., Ensign, U. S. Naval Reserve Force.
WOODWORTH, C. B., Captain, 49th Engineers, Fort Meyer, Va.

CANDIDATES FOR MEMBERSHIP

TO BE VOTED ON AFTER JULY 10

BELOW is the list of candidates who have filed applications since the date of the last issue of THE JOURNAL. These are classified according to the grades for which their ages qualify them, and not with regard to professional qualifications, i.e., the ages of those under the first heading place them under either Member, Associate or Associate-Member, those in the next class under Associate or Associate-Member, those in the third class under Associate-Member or Junior, and those in the fourth under Junior grade only. Applications for change of grading are also posted. Total number of new applications, 79.

The Membership Committee, and in turn the Council, urge the members to scrutinize this list with care and advise the Secretary promptly of any objections to the candidates posted. All correspondence in this regard is strictly confidential. Unless objection is made to any of the candidates by July 10, and provided satisfactory replies have been received from the required number of references, they will be balloted upon by the Council. Those elected will be notified about July 15.

NOTE. The Council desires to impress upon applicants for membership that under the present national conditions the procedure of election of members may be slower than under normal conditions.

NEW APPLICATIONS

FOR CONSIDERATION AS MEMBER, ASSOCIATE OR ASSOCIATE-MEMBER

Connecticut

BALDWIN, CHARLES A., Assistant General Sales Manager, Bridgeport Brass Co., Bridgeport

LUDEMAN, OSCAR H., Engineer and Salesman, The Spencer Tubine Cleaner Co., Hartford

SHAW, STILLMAN, Mechanical Engineering —Lorenz & Lorenz, Hartford

Delaware

CRAIG, WILLIAM D., Engineer, Atlas Powder Co., Wilmington

District of Columbia

DOYLE, EDMUND A., 1st Lieutenant, Engr. R. C., U. S. Army, Washington

FISCHER, LOUIS A., Major, Ordnance Reserve Corps, Bureau of Standards, Washington

Georgia

PERRY, HIRAM W., General Superintendent, Yaryan Rosin & Turpentine Co., Brunswick

Illinois

MCWETHY, FRANK H., Secretary, Stephens-Adamson Mfg. Co., Aurora

OLSON, CARL G., Chief Engineer, Illinois Tool Works, Chicago

Maryland

SYMINGTON, THOMAS H., President of the several Symington Companies, Baltimore

Massachusetts

GRADE, OSCAR W., Mechanical Engineer, Worthington Pump & Machy. Corp., Blake & Knowles Works, Cambridge

HARVEY, JOHN C., with C. M. Allen, Engineer, also owner and manager Haynes automobile business, Worcester
INGRAM, EDWARD H., Mechanical Engineer, Greenfield Tap & Die Corp. Greenfield
JONES, EVAN F., Treasurer and General Manager, Morgan Spring Company, Worcester
LINCOLN, FRANK S., Machine Purchase & Tool Designer, Construction Department, Watertown Arsenal, Watertown
REID, ALEXANDER, Manager of Water Wheel Dept., Holyoke Machine Companies, Worcester

New Jersey

FRENCH, CHARLES M., 1st Lieutenant, Engineers R. C., 34th Engineers, Camp Dix
GIBBONS, ARCHER, Manager of General Office Service Departments of Thomas A. Edison, Inc., Orange
PARRISH, SAMUEL M., Power Supervisor, The Celluloid Co., Newark

New York

LATTER, EDWARD D., Industrial Engineer, with Federal Accounting Corp., New York
MOREAU, L., Engineer, with M. M. Schneider & Co., New York
POLLARD, WRIGHT, Supervisor, Remington Arms & U. M. C. Co., Inc., Ilion
POTTER, JOSEPH S., General Superintendent, Gas Engine & Powder Co., & Charles L. Seabury & Co., Consol., Morris Heights
VAN BOMEL, LEROY A., President, Sheffield Condensed Milk Co., Inc., Asst. General Manager, Sheffield Farms Co., Inc., President, High Bridge Garage, Inc., New York
WILDER, ROBERT H., General Inspector, American Metal Products Corp., New York
WAINRIGHT, WALTER S., Engineer, Walter Kidde & Company, Inc., New York

North Carolina

MACEWAN, THOMAS A., Mechanical Construction Engineer in Private Practice, Greensboro

Ohio

LEAHY, FRANCIS W., Inspector of Machinery, U.S.S.B. Emergency Fleet Corp., care of Hooven, Owens, Rentschler Co., Hamilton
MCCONKEY, WALTER N., Shop Engineer, Lima Locomotive Works, Inc., Lima
RUCK, EDWARD H., Chief Engineer, The Cleveland Tractor Co., Cleveland

Pennsylvania

BUCK, CHARLES A., Vice President, Bethlehem Steel Co., Bethlehem
ENZIAN, CHARLES, Mining Engineer, Philadelphia and Reading Coal and Iron Co., Pottsville
GUTHRIE, BAYARD, Superintendent of Crucible Works, Crucible Steel Co. of America, Pittsburgh
HOFAMMANN, KARL E., Assistant Foreman, Pennsylvania Railroad Company, Altoona
SCHLATTER, LOUIS H., Assistant Foreman, Pennsylvania R.R. Co., Test Dept., Altoona

Tennessee

SEWELL, CHARLES B., Saw-Mill Designer and Builder, Newport

Virginia

VANDEGRIFT, WAYNE A., Supt. of Const., J. W. Danforth Co., Naval Base Station, Norfolk

Wisconsin

ERBACH, WILLIAM L., Vice-President & Manager, Rietbrock Land & Lumber Co., Athens

Canada

COSLER, ARTHUR S., Adviser on Pulp-Mill Construction, Fraser Companies, Ltd., Edmundston, N. B.
FRASER, DUNCAN W., General Manager, Montreal Locomotive Works, Ltd., Montreal

Canal Zone

HEDGES, SELBY E., Plant Draftsman, Mechanical Division, Panama Canal.

South America

BARKER, EDGAR E., Superintendent of Mines, Cerro de Pasco Copper Corp., Cerro de Pasco, Peru

FOR CONSIDERATION AS ASSOCIATE OR ASSOCIATE-MEMBER

Alabama

DREXELIUS, GEORGE W., Local Manager, The Fairbanks, Birmingham

Illinois

REDFIELD, EDMUND R., Mechanical Engineer, Russell, Burdsall & Ward, Bolt & Nut Co., Rock Falls

Iowa

NICHOLSON, JAMES M., Fuel Supervisor, care of A. T. & S. F. Ry. Co., Fort Madison

Michigan

LANGILL, ROSS E., Chief Engineer, Sawmill Dept., The Prescott Co., Menominee

Missouri

HILL, WILLIAM S., Superintendent, Light & Power Dept., Springfield Gas & Electric Co., Springfield

New Jersey

PONSEN, LYAS, Power-plant Engineer, Babcock & Wilcox Co., Bayonne

New York

GRAHAM, WARREN W., Mechanical Engineer, Ford, Bacon & Davis, New York

Pennsylvania

BENNETT, LELAND W., Instructor, Dept. Mechanical Engineering, University of Pennsylvania, Philadelphia

FOR CONSIDERATION AS ASSOCIATE-MEMBER OR JUNIOR

District of Columbia

COLLINS, LESTER W., Investigator in Marketing Fruits and Vegetables, Bureau of Markets, Washington

Massachusetts

STRUCK, HENRY W., Mechanical Designer, Stone & Webster, Boston
TUCKER, HAROLD B., Asst. Supt. Const., Merrimac Chemical Co., No. Woburn

Minnesota

KOPPER, EDWARD, JR., Chief Engineer, Minnesota Manufacturers' Assn., North St. Paul

Nebraska

BIRD, FRANK S., Superintendent of Construction, Phoenix Construction Co., Omaha

New Jersey

BELDING, LEWIS A., Assistant Professor of Mechanical Engineering, Stevens Institute of Technology, Hoboken.
RILEY, ARTHUR B., Sergeant, 1st Class, in charge of road construction, Utilities Dept., Quartermaster Corps., U. S. Army, Camp Merritt
SCOTT, WALTER C., Manager and member of firm—Walter Scott & Co., Plainfield

New York

ANDRESEN, JOHN H., JR., Mechanical Superintendent, New York American Journal, New York
BROOKS, JOHN, Assistant to General Manager, Russell Motor Car Co., Inc., Buffalo
SANBORN, ARTHUR P., Engineering Ensign, U.S.N.R.F., Section Base, No. 8, Tompkinsville, Staten Island

Ohio

BOHANNON, GEORGE L., Chief Engineer, The Youngstown Steel Car Co., Youngstown
DRUMMOND, JOHN H., President, The Drummond-Miller Co., Cleveland

Pennsylvania

BAGLEY, GLEN D., Engineer for Mellon Institute of Industrial Research, Pittsburgh
PRUDDEN, THEODORE M., 1st Lieutenant, Ordnance Dept., R. C., Frankford Arsenal, Philadelphia
SMITH, VICTOR J., 1st Lieutenant, Ordnance R. C., U.S.A., Frankford Arsenal, Philadelphia

Virginia

MCCLAVE, BERNARD D., Captain, Sanitary Corps, N.A., Assigned to A. S., S. C., Hampton

West Virginia

KAUFMAN, MORRIS L., Engineer in Cotton Purification Dept., Staff of Lt. Col. Arthur Wass, Nitro

FOR CONSIDERATION AS JUNIORS

California

BEATTIE, JOSEPH A., Assistant Engineer, Board of Public Utilities, Los Angeles

Connecticut

STURTEVANT, HENRY S., Mechanical Engineer, S.K.F. Ball Bearing Co., Hartford

Indiana

DAVIDSON, JOHN L., Chief Inspector for the Ordnance Department, U. S. Army, care of The Illinois Steel Co., Gary

Maryland

BELL, WALTER M., Engineer, U. S. Filling Plant, Co. B., Gunpowder Reservation, Edgewood

Michigan

MEHARD, HUGH R., Time Study Chief and Efficiency Engineer, The Aluminum Castings Co., Detroit

New Jersey

GOTTLIEB, SOLOMON, Departmental Manager, American Lead Pencil Co., Hoboken

New York

LEGGE, ELMER E., Mechanical Engineer and Metallographist, Watervliet Arsenal, Watervliet
WATKINS, ROY A., Ensign, Instructor, Columbia University, New York

Pennsylvania

MARQUARDT, WILLIAM C., Asst. Superintendent, Nelson Valve Co., Philadelphia
MCCABE, P. CHARLES, Heating Engineer, The Austin Company, Philadelphia

Canada

GUSTAFSON, ALFRED O., Checker, Engineering Dept., Willys-Overland, Ltd., West Toronto

APPLICATIONS FOR CHANGE OF GRADING

PROMOTION FROM ASSOCIATE-MEMBER

Connecticut

PIGOTT, REGINALD J. S., Superintendent, Raw Material Depts., Bridgeport Brass Co., Bridgeport

New York

HATCH, EDWIN G., Consulting Engineer and Manufacturer, New York

Pennsylvania

BRYANS, HENRY B., Engineer, Counties Gas & Electric Co., Norristown

PROMOTION FROM JUNIOR

District of Columbia

HALSEY, WILLIAM D., Asst. Professor, Mechanical Eng., Geo. Washington University, and Mechanical Engineer with National Advisory Committee for Aeronautics, Washington

Massachusetts

HAYES, J. HOWARD, Member of firm, E. H. Hayes Machinery Co., Boston

New Jersey

ABRAMS, FRANK W., Asst. Superintendent, Standard Oil Company, Jersey City

SMITH, WILLIAM E., Traveling Engineer, Babcock & Wilcox Co., Bayonne

STROUSE, SIDNEY B., General Engineering Practice and District Manager for Warren Webster & Co., Atlantic City

New York

GATES, JOHN G., Production Superintendent, Sperry Gyroscope Company, Manhattan Bridge Plaza (Reinstatement), Brooklyn

Ohio

RENTSCHLER, GORDAN S., Vice-President and Works Manager, The Hamilton Foundry & Machine Co., Hamilton

Pennsylvania

BICKLEY, JOHN H., Designing Hydraulic Engineer, W. H. Wood, Media

LEWIS, GEORGE C., Chief Engineer, Hersh & Brother, Allentown

MANN, HARVEY B., Department Manager and Director, Dravo-Doyle Company, Pittsburgh

SUMMARY

New applications	79
Applications for change of grading:	
Promotion from Associate-Member	3
Promotion from Junior	10
Total	92

SUMMARY SHOWING AVERAGE AGE AND POSITIONS OF APPLICANTS ON BALLOT OF MAY 29, 1918

AVERAGE AGE OF APPLICANTS

Members	39
Associates	42
Associate-Members	37
Juniors	2

POSITIONS OF APPLICANTS

Chief Engineer	24
Chief Engineer (Asst.)	3
Chief Draftsman	11
Chief Draftsman (Asst.)	2
Construction Engineer	5
Construction Engineer (Asst.)	1
Consulting Engineer	16
Consulting Engineer (Asst.)	1
Cost Accountant	1
Designers	17
Draftsmen	17
Editor	1
Estimator	1
Executive (Pres., V.P., Treas., Secy., Manager)	51
Factory Manager	2
Field Engineer	1
Foremen	4
Foremen (Asst.)	11
Fuel Engineer	2
Gas Engineer	1
Industrial Engineer	5
Inspectors	15
Inspectors (Chief)	4
Inspectors (Asst.)	1
Junior Engineers	2
Machinist	1
Manufacturer	1
Master Mechanic	5
Mechanical Engineers	52
Mechanical Engineers (Asst.)	15
Operating Engineer	1
Operating Engineer (Asst.)	1
Power Engineer	1
Production Engineer	4
Professors	3
Professors (Assoc.)	2
Professors (Asst.)	6
Purchasing Engineers	1
Purchasing Engineer (Asst.)	1
Representative	2
Resident Engineer	3
Resident Engineer (Asst.)	1
Salesman (Engineers)	8
Sales Manager	1
Shop Engineer	1
Standardization	1
Superintendents	18
Superintendents (Asst.)	9
Testing Engineers	4
Works Managers	5
Works Managers (Asst.)	4
Miscellaneous	28

UNITED STATES GOVERNMENT SERVICE

Captains	2
Lieutenants	2
First Lieutenants	3
Second Lieutenants	1
Aeroplane Designer	1
Electrical Gunner, U.S.N.R.F.	1
Naval Inspector of Machy	1
Naval Inspector, Ord	1
Sig. Corps—Aerological Wk	1

EMPLOYMENT BULLETIN

THE SECRETARY considers it a special obligation and pleasant duty to make the office of the Society the medium for assisting members to secure positions, by putting them in touch with special opportunities for which their training and experience qualify them, and for helping any one desiring engineering services. The Society acts only as a clearing house in these matters.

GOVERNMENT POSITIONS

Stamps should be inclosed for transmittal of applications to advertisers; non-members should accompany applications with a letter of reference or introduction from a member; such reference letter will be filed with the Society records.

Members applying in person for Government positions at such places as Navy Yards should invariably make appointments beforehand by letter, telephone or telegraph, and arrange to have passes or the equivalents so that they can gain entrance. In this way they will avoid disappointment.

TECHNICALLY TRAINED MEN AS INSTRUCTORS in Government schools for automobile mechanics and military aeronautics. Men within the draft age can be used for this work, provided they have not already been called by their Local Draft Board. 2611.

ASSISTANT RESIDENT INSPECTORS. Several recent graduates of technical schools to supervise the construction work on hulls and installation of the machinery. Salaries from $1200 to $1500. Location, New York. 2612-A.

SEVERAL ENGINEERS of mature experience and with some acquaintance with the principal parts of steamships to be in office to help in directing work. Salaries range from $1500 to $3000. Location, New York. 2612-B.

DIESEL ENGINEER. Technical department of Emergency Fleet Corporation requires the service of experienced Diesel engineer who should also have knowledge of shop practice. 2613.

NUMBER OF HIGH-GRADE TECHNICAL MEN wanted for positions in industrial establishments by the United States Army Ordnance through the Civil Service, as follows:

SUPERINTENDENTS for plants engaged in chemical manufacturing processes; salaries range from $2400 to $6000. Assistant superintendents of nitrate and chemical plants, $1600 to $2400.

CHEMICAL ENGINEERS to have complete supervision over one or more chemical manufacturing processes incidental to the war. Salaries from $2400 to $6000. Some with less experience as chemical engineers to receive from $1600 to $2400.

GAS-MANUFACTURING EXPERT to receive $1600 to $2400 a year.

MECHANICAL ENGINEERS experienced in operation and control of high-pressure hydraulic and gas machinery. Salaries for junior mechanical engineers from $1600 to $2400.

POWER-HOUSE ENGINEERS for supervision of operation. Salaries from $1800 to $2400.

MACHINE-SHOP FOREMEN. Salaries $1800 to $2400 a year.

Education and experience of men will qualify them without necessity of Civil Service Examinations.

Persons of military age accepting appointment will not avoid the obligations of the Selective Service Law. No application will be accepted from employees of firms or corporations engaged in contracts for the Government or its Allies unless written assent to such application is given by the head of the establishment that might be seriously handicapped in its war work by the loss of the man.

Many positions are open. The needs of the service, the Ordnance Department announces, are so imperative that applications will be received indefinitely. Further information regarding the Army Ordnance positions that must be filled is obtainable from the Civilian Personnel Section, United States Army Ordnance, 1330 F Street, Washington, D. C.

CIVILIAN POSITIONS

EXPERIENCED COPY WRITER to handle building construction and equipment accounts; exceptional opportunity with New England agency for man who knows the contracting field and can show satisfactory evidence of ability through copy and catalogue matter already written. 0267-F.

MECHANICAL DRAFTSMAN, preferably draft-exempt, for machinery and building layouts, mill specifications, design of experimental and new machinery. Permanent position. Attractive surroundings. Location, New Hampshire. 0268-F.

YOUNG MEN for sales, productive and experimental engineering work in large electrical manufacturing firm in Middle West. Applicants must have complete high-school training and the equivalent of at least two years' technical training; preferably be technical graduates from a university of good standing. In reply state training and experience in detail, salary desired, draft classification and references. 0269-F.

POWER SUPERINTENDENT to take charge of a large power plant near New York City. In reply state nationality, age, education, experience in full, and salary expected. Location, New Jersey. 0275-F.

SUPERINTENDENT of textile machine-shop, employing 50 men; preferably a graduate of Mass. Inst. Technology. Location, New Jersey. 0276-F.

COST CLERK AND ACCOUNTANT for concern manufacturing structural steel materials and hardware specialties; familiar with modern methods of accounting, statistical work and cost keeping. Familiarity with stenography of advantage. Location, New York City. 0277-F.

DRAFTSMAN experienced in machinery, pipe layouts, etc. Salary, $40. Headquarters, New York. 0278-F.

MECHANICAL ENGINEER to increase production and development of goods. Location, Middle West. 0279-F.

ASSISTANT TO HEAD OF BALLOON DEPARTMENT. Must speak French. Competent to develop production and improvements in design. Location, Middle West. 0280-F.

EXECUTIVE, of college-professor type, with personality to meet and gain confidence of customers and direct the activities of a large physical laboratory. Location, Middle West. 0281-F.

DIRECTOR OF WELFARE WORK and general plant coöperation with heads of departments and employees. Location, Middle West. 0282-F.

ASSISTANT SUPERINTENDENT in large paper-box manufacturing plant. Man with technical education preferred. Experience in manufacturing desirable. Position requires man with tact and ability to handle large amount of detail. Location, Indiana. 0284-F.

MECHANICAL ENGINEER to oversee the testing of fabrics, glue, dope, varnish, structural tests, sand-load panels, etc. Location, Buffalo. 0285-F.

MASTER MECHANIC to take entire charge of maintenance work, including machinist, millwright, carpenter, electrical and pipe-fitting work. Salary about $150 per month to start; good chance for advancement. Locality, Brooklyn. 0286-F.

STATISTICIAN to compile engineering data. Recent college graduate preferred. Salary, $25 per week. Locality, New Jersey. 0287-F.

ASSISTANT EMPLOYMENT MANAGER. Man of some mechanical training wanted. Location, Connecticut. 0288-F.

DRAFTSMEN for Connecticut plant. Men of recognized ability desired. 0289-F.

TIME-STUDY WORK for men of ability. Location, Connecticut. 0290-F.

DRAFTSMAN, designer of hoisting engines and hoisting machinery generally. American citizen. Salary $150 to $200 a month. Must be experienced and capable designer. 0291-F.

DRAFTSMAN, of good education; experienced in steam-piping work, ventilating, etc. Salary $100. 0292-F.

ASSISTANT TO GENERAL SUPERINTENDENT of Canadian plant. Chemical graduate. Previous experience in the manufacture of smokeless powder very much desired, though not absolutely necessary, or previous experience in the manufacture of powder for high explosives. Salary, $3000 to $3500. 0293-F.

MECHANICAL DRAFTSMAN of not less than two years' experience to work in engineering department of well-established and growing business, doing light structural and mechanical work. State age, nationality, education and experience, also references, accompanying reply with sample of lettering. Location, New York City. 0294-F.

DRAFTSMEN for plant layouts of machinery and equipment. Location, New York. 0296-F.

ASSISTANT ENGINEER, graduate of ability and initiative. Experience in structural steel work and supervision of construction desirable. Location, Illinois. 0295-F.

CHIEF ENGINEER for cement corporation plant aggregating 3000 hp., and comprising Corliss engines, a. c. generators, motors, etc.; plant in excellent condition. 0297-F.

FACTORY SUPERINTENDENT, 31 years of age or over, to take charge of works for factory employing about 200 men. One who has had an all-round experience and capable of handling employees. Salary at start, between $4000 and $5000. Location, New York. 0298-F.

MACHINE DESIGNER with some experience in electrical apparatus, and familiar with automatic-machine design and electrical appliances. Salary from $1800 to $2400. Location, New York State. 0299-F.

DESIGNING DRAFTSMEN, with some experience on printing-press work and shop experience. 0300-F.

DRAFTSMEN, experienced in boiler and power-plant equipment, able to check drawings. Salary depends on man. Location, New York City. 0303-F.

YOUNG TECHNICAL GRADUATE to develop as superintendent. Must be draft-exempt or above draft age and have personality to handle men. Salary $2000 to $2600. Location, New Jersey. 0304-F.

MAINTENANCE MECHANICAL ENGINEER, for plant employing 5000 men. Experience in belt transmission, electric, steam, air and gas service, plumbing, etc., and as millwright, tinsmith, electrician, etc. Salary depends on man. Location, New Jersey. 0305-F.

MECHANICAL DRAFTSMEN, conveying machinery. Young technical graduates preferred. Salary, $125. Location, New York. 0306-F.

ENGINEERS and ASSISTANT ENGINEERS in forest products. Work embraces principally investigations of mechanical and physical properties of wood in airplane construction, methods of artificial drying, etc. Salaries range from $1800 to $2400 for engineers, and from $1200 to $1500 for assistant engineers. Location, Wisconsin. 0307-F.

ASSISTANT, to take charge of design and construction of motors, etc., in shop. Personality essential factor. Technical graduate preferred. Salary, $2500. Location, New York. 0308-F.

OPERATING ENGINEER, high-grade man for light, heat and power. Location, New Jersey. Salary depends upon man. 0311-F.

SALES ENGINEER for large corporation; experience in sale of semi-Diesel fuel-oil engines. Only high-class salesman with successful record considered. 0313-F

DRAFTSMEN, mechanical, electrical, structural, reinforced concrete. Location, Pennsylvania. 0314-F.

OFFICE ENGINEER to take charge of complete design of blast furnaces, steel plants, power plants, etc. Location, Ohio. 0315-F.

YOUNG ENGINEER, over draft age, single, to go to head office in Chile, S. A., of company operating several plants in nitrate district; should have some experience in industrial cost analysis and efficiency work, in addition to general engineering experience. Salary, $3000 a year to start. 0316-F.

PLANT ENGINEERS or HIGH-GRADE DRAFTSMEN for plant engineering work, Location, New Jersey. 0317-F.

ASSISTANT EMPLOYMENT SUPERVISOR to secure men for Government work. Salary depends on man. Must be American citizen. Location, Brooklyn. 0318-F.

ENGINEERS to travel throughout the country and get in touch with employers and

with men not engaged in war work, and to secure competent men for concerns doing Government work. Location, New York. 0319-F.

PRODUCTION ENGINEER, man with good executive ability. Location, Michigan. 0320-F.

MAN WITH MECHANICAL AND BUSINESS ABILITY, who understands sheet-iron work, capable of taking charge of a small plant. Permanent position. Location, New York. 0321-F.

DRAFTSMAN wanted for mechanical department of smelter plant producing spelter and sulphuric acid. Locality, Pennsylvania. 0323-F.

HIGH-GRADE SHOP EXECUTIVES FOR IMPORTANT WAR WORK, shop superintendents, shop foremen, master mechanic, construction engineer. 0326-F.

SALES MANAGER to organize sales force for concern manufacturing metal-sawing products. Salary, $5000. 0327-F.

EXECUTIVE FOR ENGINEERING DEPARTMENT to take charge of technical end of steam and power-pump line. Locality, Kentucky. 0328-F.

MECHANICAL DRAFTSMEN with technical education, experienced in vacuum-heating systems and high-pressure steam-piping. Location, New York City. 0329-F.

ORGANIZATION MAN to handle placing of orders and correspondence relative thereto for forgings. Position would be one of considerable importance and would require accuracy, a good knowledge of correspondence, planning, scheduling, etc. Salary, $3000. Location, Washington, D. C. 0330-F.

DRAFTSMEN in architectural lines for work on factory buildings. Location, New York. 0334-F.

YOUNG MAN, DRAFT EXEMPT, for sales department at general office of large corporation. With mechanical education, sales-department experience, preferably familiar with semi-Diesel fuel-oil engines. State education, age, experience, etc. Applications strictly confidential. Location, Michigan. 0335-F.

DRAFTSMEN with experience in conveying machinery and general engineering. Salary, $175 to $200. Location, New Jersey. 0336-F.

YOUNG ENGINEER with executive ability, and some experience, to serve as master mechanic in charge steam and electric plants and kilns, and general maintenance. Location, Michigan. 0337-F.

ENGINEERS, DESIGNERS and DRAFTSMEN wanted for work of research, development, and design related to problems of telephonic, telegraphic and radio communication which are matters of public importance. Both temporary and permanent positions are open. Location, New York. 0338-F.

YOUNG ENGINEER to start with growing concern in drafting and miscellaneous work, estimating, superintending construction work, etc. Salary not over $1200 to start. Headquarters, New York. 0339-F.

PRODUCTION MANAGER with estimating experience in machine shop and on machine tools. Men of 30 to 40 years of age preferred. Salary, $2500 to $3000. Location, New York City. 0340-F.

TOOL MAKERS, DESIGNERS or MACHINISTS for manufacture of dies, gages, jigs and fixtures. Location, New Jersey. 0341-F.

DRAFTSMAN, on vertical triple-expansion marine engines for shop in western New York. Permanent position and excellent opportunity for the right man. 0342-F.

ENGINEER to head section interested in fuel problems connected with Government power plants, also carrying on laboratory investigations of boiler-room instruments, devices and house-heating apparatus. Man is needed to head section who has leaning toward investigation work rather than the commercial phase of engineering. Salary, $2500. 0343-F.

INVESTIGATOR in powdered-fuel work, for Government laboratories, one not interested in any commercial organization of powdered-fuel industry; must be well posted and able to follow the needs of this field by laboratory investigations. Salary, $2500. 0344-F.

ENGINEERING CHEMIST, specially proficient in tests of city gas plants and the production of retort coke. Salary, $2500. Location, Illinois. 0345-F.

DRAFTSMEN. Some experience in chemical plants. Location, New York. 0346-F.

MECHANICAL DRAFTSMEN, experienced in power-transmission and machinery layouts. Work in question will probably be over two months' duration and good salaries will be paid competent men with traveling expenses from New York to West Virginia and return, and living quarters. 0347-F.

FACTORY SUPERINTENDENT. Prominent corporation, manufacturing light product of large variety, part stock, part special to order, requires aggressive, energetic factory superintendent, thoroughly experienced in machine-shop practice and modern centralized planning control methods, capable of securing large production efficiently and economically. To be considered, replies must fully state experience and qualifications. 0348-F.

MAINTENANCE ENGINEER for machine shops and foundry of growing plant in Providence. Technical graduate preferred. 0349-F.

YOUNG CONSULTING ENGINEER, to act as personal understudy to consulting engineer. Man who has mechanical-engineering ability combined with all the knowledge of economics and statistics possible. Prefer man three years out of college, exempt from draft. Unusual opportunity through the educational features of the work. 0351-F.

MECHANICAL DRAFTSMEN. Men familiar with large power-station work. Immediate work in hand is the installation of a 20,000-kw. turbo-generator with the necessary condensing apparatus, boilers, stokers, coal and ash-handling apparatus, etc. Salary $150 per month. 0352-F.

MACHINE DESIGNERS on fixtures, jigs, etc. Flat salary of $35 and opportunities at high rates by the hour. Location, Connecticut. 0363-F.

LABORATORY INSTRUCTOR for large New York City University, one capable of taking charge. Work covers the entire range, with the exception of materials testing, and includes hydraulics. 0354-F.

SALES ENGINEER, one energetic and willing to work. Must be a thinker. Engineering college degree with some experience in shop work and machine design, or a high-school education with two or three years' shop work and machine design. Must be between 25 and 32 and draft-exempt, or in class 4. Salary, $1500 to $1800. Location, New Jersey as headquarters. 0355-F.

MEN AVAILABLE

Only members of the Society are listed in the published notices in this section. Copy for notices should be in hand by the 12th of the month, and the form of notice should be such that the initial words indicate the classification. Notices are not repeated in consecutive issues.

MECHANICAL AND EFFICIENCY ENGINEER, Member, age 37, married; 16 years' wide experience in mechanical and electrical engineering, seven years of which was as directing engineer with large professional efficiency-engineering company. Reason for changing is that present position does not permit of future advancement. Desires position of executive nature with progressive concern where ability will be recognized and responsibilities increased proportionally. Only permanent connection will be considered. F-146.

GENERAL MANAGER of light and power company, for past seven years in responsible position in steam-driven electric and ice-making plant, desires similar position with company having larger field. American born, 39 years of age; high-class reference; well versed in plant upkeep and operation. F-147.

MECHANICAL-ELECTRICAL ENGINEER, technical graduate 1904, now employed as mechanical engineer and superintendent of two modern turbine steam plants and gas plant, desires to make connection with progressive public utility or industrial plant where ability, integrity, and reliability will be appreciated. Experienced in handling men, in design, construction and maintenance of high and low-voltage stations, steam plants, piping, machinery, buildings and various kinds of steam and electrical equipments. Unusual business and technical training. Speaks French fluently. Best references. Location preferred, Eastern States. Salary, $3000 per year. F-148.

MECHANICAL ENGINEER, M. E. graduate, age 32, not in draft, married; eight years' experience in design and manufacture of automobiles, motor trucks, spark plugs, production tools, small punch and die work, inspection gages, and a large variety of small and medium sized special and semi-automatic machinery. Two years in executive position. Thorough and systematic. General knowledge of accounting principles and efficiency work. Salary secondary to opportunities and surroundings. At present employed. F-149.

SALES ENGINEER, electrical-mechanical, technically trained, age 35; speaks Spanish and Portuguese fluently, and has good knowledge of Italian and French. At present employed, but desires to change to larger possibilities. F-150.

GENERAL SUPERINTENDENT, mechanically and technically trained, thoroughly conversant with modern methods of produc-

tion and planning control systems of scientific management. Twenty years' experience in the manufacture of typewriters, adding machines, magnetos, speedometers, ball bearings, artillery ammunition, etc. Capable of assuming entire control of large scale production enterprises. Salary, $5000. F-151.

METALLURGICAL ENGINEER, Junior member and technical graduate, age 27, single, draft-exempt, desires position as assistant executive in production or control work. Has had broad experience covering foundry, machine shop, cost, drafting, efficiency and construction work. Has specialized in metallography, electrometallurgy and pyrometry. Salary will depend on future possibilities. F-152.

GENERAL SUPERINTENDENT OR SUPERINTENDENT. Associate-member, diplomatic and forceful executive, accustomed to supervising from one hundred to one thousand employees. Fifteen years' general mechanical experience. F-153.

MECHANICAL ENGINEER, age 35, technical graduate with thirteen years' experience in the design and manufacture of railway supplies, and as factory engineer designing and supervising the installation of mechanical equipment of all kinds in modern manufacturing plant, desires position as works engineer or assistant in manufacturing plant or as mechanical engineer, with engineering firm designing and installing industrial plants. Salary, $2700 to $3000. Location, Chicago or vicinity preferred. F-154.

ELECTRICAL AND MECHANICAL ENGINEER, married, nine years' experience on power-station operation and construction work. Has been in charge of large hydro-electric stations, high-voltage transmission system and sub-stations. Desires executive position with large power or holding company. F-155.

ASSISTANT ENGINEER. Junior member, technical graduate 1914, age 25, married, in Class IV of draft, in present position since graduation, thorough drafting and engineering experience, desires position of responsibility in small to medium-sized industrial plant preferably in New England, manufacturing standardized product. F-156.

MECHANICAL ENGINEER desires to associate with consultant or industrial firm as expert on tools and production methods. Available for two or three days a week only, as balance of time is being devoted to development and manufacture of standard shop appliances for munitions plants. Location, Philadelphia. F-157.

EXECUTIVE. Junior member, graduate of Massachusetts Institute of Technology, 35 years of age, ten years' continuous service with present concern, advancing from draftsman to superintendent, desires opportunity for larger service. Experienced in shop management, embracing tool and machine design, stock and toolroom organization, planning and routing work, handling men and producing, shop accounting, and modern methods of payment. A student of, and believer in, scientific management, and anxious to develop along such lines. Minimum salary, $4500. Available after two weeks' notice. F-158.

PRODUCTION MANAGER OR WORKS MANAGER. Member, graduate mechanical engineer, several years' experience in the manufacture of transmission and special machinery, and especially familiar with the planning and organizing of plants for intensive production of duplicate parts. Now doing Government work but will be available about June 15. Best of references. F-159.

MECHANICAL ENGINEER with executive ability. Technical graduate, 13 years' experience in the design, construction and operation of power plants and general manufacturing machinery. Well experienced in the production and application of electricity in manufacturing plants. Specializes in operation of plants and manufacturing equipment, including the economical combustion of fuel. F-160.

EXPERIMENTAL ENGINEER, technical graduate, five years' designing experience; at present experimental engineer with large manufacturing concern. Munition work preferred. F-161.

SUPERINTENDENT OR PRODUCTION MANAGER. Member, technical graduate, age 36, strong disciplinarian and successful handler of men; well up on efficiency, rate setting, cost accounting and modern shop management, desires new connections with company operating a foundry or machine shop or both. Present salary, $4000 per year. F-162.

WORKS MANAGER, at present employed by large concern in charge of factory. Experienced in manufacture of machinery and details of factory management, also power-plant operation. Energetic, good personality and best of reference covering more than 15 years with present employers. Technical education. Age 47. Desires change to increase possibilities. Prefers location near New York. F-163.

MECHANICAL ENGINEER. Member, American, age 36, technical education, married. Expert designer of complex appliances and special machinery; 16 years' practical experience in modern drafting-room methods, shop practices, manufacture, erection and tests. Desires position as engineer, head of drafting department or similar position of responsibility. Detailed information on request. F-164.

MECHANICAL ENGINEER AND EXECUTIVE with 12 years' experience in drafting, elevator and power-plant construction, manufacturing and sales work, desires new connections with a growing concern requiring the services of an executive with initiative and aggressiveness. Location no object. Minimum salary, $2300. F-165.

EXECUTIVE. Graduate mechanical engineer, American, with unusually broad business and engineering experience in this country and in Europe. Can handle men and coördinate work of different departments. Particularly successful in adjusting contract disputes in matters involving expert technical knowledge. Acquainted with modern production methods, and understands principles of accounting. Writes clear, forcible English. Can fill acceptably any responsible position in a manufacturing establishment. Would make exceptionally good assistant to chief executive of very large and complicated business. Worth an interview at least. F-166.

MECHANICAL ENGINEER, married, specialized in power-plant equipment, design and testing of marine apparatus; also condensers and spray-cooling systems. Had charge of sales office. F-167.

ASSISTANT TO EXECUTIVE. Age 33, technical graduate of Yale. Eleven years' experience along several lines of manufacture. Has held positions of draftsman, assistant engineer, surveyor, engineer in charge of improvements and reconstruction, plant manager and assistant to president. Good knowledge of industrial equipment and purchasing; competent to assume responsibility and handle detail work as well as correspondence as an executive. Interested worker. Desires to locate with growing company offering executive future and permanent position. At present engaged. East or Middle West. F-168.

MECHANICAL ENGINEER. Industrial and power-plant experience. Desires responsible position. F-169.

MECHANICAL ENGINEER. Member, American, age 48, experienced in mill designing and operating, hydraulic power development and water storage, now employed, desires change. Capable manager and executive officer. F-170.

MECHANICAL ELECTRICAL ENGINEER, Columbia graduate, sales manager or superintendent. At present employed as manager of a very large concern. Experience in internal-combustion engines, gas producers, power installations, foundry and machine-shop practice and marine power plants. Unusual business and technical training. Fully conversant with French, Italian and Spanish. Minimum salary to start, $4,000. F-171.

MECHANICAL ENGINEER, member, graduate, experienced in small parts manufacture and now engaged as production engineer on Government work, desires executive position in similar lines. Available in 30 days. F-172.

EXECUTIVE, MECHANICAL, and CHEMICAL ENGINEER, 39 years of age, married. Technical graduate, two years' experience abroad and 12 years in U. S. Designing, erecting and operating, cement plants, chemical plants and glass work with labor-saving machinery. Can control analytical work on raw materials and finished products such as cement and glass. Able to handle tactfully executives and employees. Employed but desires responsible permanent position in a northern state. Minimum salary $3,000. F-153.

MECHANICAL ENGINEER, American, with experience on Diesel and steam engines, also boilers, tanks and stacks. At present assistant chief draftsman with a company building oil engines. Desires executive position with a company who could use man with above experience. F-174.

MECHANICAL ENGINEER, member age 34, technical graduate with 12 years' experience covering steam-power plant design, heating and ventilation, general test and efficiency work, machine design, construction, estimating. Can work into several lines on account of broad knowledge and thorough technical ability to develop new lines of work. At present employed in capacity of consulting engineer for large oil refinery nearing completion. F-175.

CHIEF INSPECTOR, thoroughly familiar with airplane engine manufacture and testing. Technical graduate, age 38, member S.A.E. and junior member A.S.M.E. since 1906. Experienced in shop, office and sales methods gained in the engineering departments of shipyards, as assistant superintendent of a manufacturing plant, and sales manager of a machinery house in New York. Location, Middle West or Pacific Coast. Available at once F-176.

ENGINEERING SURVEY

A Review of Engineering Progress and Attainment in Mechanical Engineering and Related Fields, Including a Digest of Current Technical Periodicals and Selected Titles of Engineering Articles

National Foreign Trade Convention

THE fifth convention of the National Foreign Trade Council was held in Cincinnati, Ohio, on April 18, 19 and 20. Delegates to the number of about twelve hundred gathered there, representing a large number of manufacturers, exporters, shippers, banks, the Government, chambers of commerce, and various organizations. Mr. E. A. Muller, of Cincinnati, was appointed by President Main to represent The American Society of Mechanical Engineers.

Possibilities of the Webb-Pomerene Bill

In an address during the meeting Edwin M. Herr, Mem. Am. Soc. M. E., president of the Westinghouse Electric & Mfg. Co., spoke of the importance of coöperation in export trade. He said that we are facing as serious and critical a situation in our foreign trade, especially our foreign trade in manufactured products, as the nation faced at the sinking of the *Lusitania*, and are doing almost as little toward real preparation for the proper development of this trade as did we as a nation in preparation for the terrible war in which we are now engaged. A step of great importance to exporters is the passage of the long-delayed Webb-Pomerene bill, which legalizes combinations for export trade and permits manufacturers of a given district to organize and to work in coöperation in order to meet the far-reaching plans of our competitors in foreign fields.

Treating this same subject was a paper by George H. Charls, of the American Rolling Mill Co., presenting a plan for coöperation under the provisions of the Webb-Pomerene bill. This involved the organization of a company with a business management that would exert every effort to secure the coöperation of schools and colleges in introducing practical export trade studies, and in teaching the languages most useful in the fields of American foreign-trade enterprise. This company would adopt well-established selling methods for its organization, which would comprise the compilation of addresses of American representatives in foreign fields, lists of foreign houses, the securing of data and price quotations from the various manufacturers, the establishment of individual departments to handle the sale of different products and organizations, of a clearing house on credits, shipping rates, etc.

Magnitude of the Country's Industries

E. A. S. Clarke, of the Lackawanna Steel Company, quoted figures showing the remarkable increase in iron and steel output in 1916 over 1915, over 33⅓ per cent. The plate-making capacity of the country has been nearly doubled, standing now at about 6,000,000 tons per year, the equivalent of 18,000,000 dead-weight tons of ships, with approximately 1,000,000 tons of additional capacity under construction which, it is thought, will be in operation before the end of the year.

Other speakers referred to marked increase in production in other fields.

The production of the American potash industry has increased from an annual output of 970 tons to 42,000 tons a year in the short space of two years.

The amount of both the crude and refined oil produced has been enormously increased during the last year. The extent of the war demand for these supplies is indicated by the fact that in 1913 exports of gasoline to our allies totaled 29,000,000 gal. and in 1917 they amounted to 300,000,000 gal. Lubricating oil shows similar increase of export, the total of 103,000,000 gal. in 1913 mounting to 200,000,000 gal. in 1917. Naphtha and gasoline export records show the total of 1913 to have been 188,000,000 against some 400,000,000 gal. in 1917.

It is estimated that there are 300,000 automobiles in use by the armies on all fronts. Of these our allies have bought 45,308 from America during the last three years compared with only 410 in the two years preceding the war. Last year American export trade in automobiles exceeded $88,000,000 for 65,792 passenger cars and 14,347 trucks—most of the latter going to the countries at war. The United States Army has bought and ordered some thirty thousand motor trucks, and requirements are in sight for from ten to fifteen thousand more.

In a paper on The Influence of the Demobilization of War Industries upon World Commerce by Charles M. Muchnic, vice-president of the American Locomotive Sales Corporation, some indication of the magnitude of our war industries is obtained:

On April 6, 1918, our ordnance program included the purchase of 23,000,000 hand grenades, 725,000 automatic pistols, 250,000 revolvers, 23,000,000 projectiles for heavy artillery, 427,246,000 lb. of explosives, 240,000 machine guns and 2,484,000 rifles.

When war was declared, 123 naval vessels were building or authorized; contracts have been placed since for 949 vessels.

In February the Director-General of Military Railways placed orders for supplies valued at $142,000,000 and with an aggregate weight of 754,000 long tons; the General Engineer Depot to February 1 issued 9500 orders for material valued at $202,000,000.

Emphasizing more particularly the need for educational preparation for foreign service, Glen L. Swiggett, of the United States Bureau of Education, presented an extremely valuable paper in which he not only outlined the requirements of preparatory courses for service in foreign trade and suggested a curriculum, but summarized the courses which are now offered by schools and colleges throughout the country according to cities and states.

Cotton Convention and Exposition

An important happening during the first week in May in New York City was the convention of the National Association of Cotton Manufacturers and the American Cotton Manufacturers' Association. At the same time an exposition was held at the Grand Central Palace.

The subjects discussed covered an unusually wide range, being devoted to matters in the field of finance, economics,

home and international trade, as well as technical matters in the broad meaning of the word.

One of the most interesting meetings was devoted to a group discussion on research as an aid to industrial efficiency.

Dr. George E. Hale spoke of the work of the National Research Council, Dr. Edward R. Waidlein, of the Mellon Institute of Pittsburgh, on Science and Industry, while Dr. C. E. K. Mees presented a paper on Planning the Research Laboratory for an Industry.

The dye exhibits at the Sixth National Show were a striking proof of the adaptability of American industry to new conditions. Less than four years ago this country relied practically exclusively on importations from Germany for its dyes. Now, domestic needs are not only fully covered but a comfortable export trade in dyes is being built up.

Probably the most difficult problem which has confronted American dye makers has been the development of a supply of intermediates. The coal-tar industry was in such a crude state in this country that when war cut off foreign supplies the country lacked not only the dyes themselves but also the materials from which they are directly produced.

Now practically all of the principal dye makers are also producing intermediates, some on a very large scale. This growth of the production of intermediates has been materially assisted by direct war demands, as several of these intermediates are first by-products or produced from by-products of munitions manufacture. On the other hand, however, war demands have absorbed some of the raw materials of dye manufacture to such an extent as to cripple the production of the dyes. This is especially true of the toluine group of colors, hampered by the fact that the entire production of toluol is absorbed by the more important high-explosives production.

The greatest lesson of the show was, however, in indicating the great possibilities of peace production in America under conditions which may be expected after the termination of the war, provided, of course, the industry is not then hampered by outside interferences.

United States Railroad Equipment Standardization

The United States Railroad Administration has announced the placing of orders for 100,000 freight cars to be built to its standard specifications, and 1025 locomotives, also of its standard types.

The statement issued regarding the locomotives is as follows: "The six standard types of locomotives, two sizes of each class, are expected eventually to supersede the many miscellaneous types and varieties of locomotives now in service, embracing engines built according to five hundred or more varying specifications. This is the first time that any real forward step has been taken looking to the wide standardization of locomotive engines."

A somewhat similar announcement was made with respect to the car orders, saying, among other things, that "the adoption of these standard types, it is believed, will eventually substitute a few scientifically worked-out designs for the numerous miscellaneous varieties of the cars representing probably more than a thousand different old styles and specifications now in use, the accumulation of the past."

This policy has been received not without criticism on the part of the technical press. Thus, the *Railway Age* (May 10, 1918) points out that the adoption of these standards has not been made for the purpose of saving time, but indicates definite tendencies to standardize thoroughly the entire motive power and car equipment of the railroads.

The tentative specifications of the standard locomotive were published in the *Railway Age Gazette* for April 19, 1918.

In the main, it appears to have been the desire of the committee designing the locomotives to provide types which will best meet average conditions.

The locomotives are all designed to traverse 19-deg. curves and grades of 2 per cent. The clearance limitations are practically alike, the overall height being 15 ft., with the exception of the heavy Santa Fe and the 2-8-8-2 Mallet, which have height clearance of 15 ft. 9 in. The width of cylinders is also the same for all designs, with the same exceptions as above.

The freight locomotives of the Mikado, Santa Fe and Mallet types cover fairly well the range of tractive efforts for that kind of service, comprising six types from 54,600 lb. to 106,000 lb., and, in addition, the boiler factors of the heavy Mikado and two Santa Fe-type locomotives are sufficiently high to permit increased tractive effort by increasing the boiler pressure.

Fear has been expressed that there may be difficulties, particularly around terminals at low bridges, also on some tunnels. Thus the Hoosac tunnel of the Boston & Maine has a height clearance of 14 ft. 8 in., which will prevent any of the standard locomotives passing through the tunnel.

The tentative specifications for the standard steel-sheathed box car have been published in *Railway Age* for April 12, 1918. In its basic features it is the same as other standard box cars, and is to be carried on the standard 50-ton truck.

The most interesting details refer, of course, to the superstructure. In this respect the designs called for an ⅛-in. steel sheathing with a 13/16-in. lining at the sides and ends, and a steel roof of 3/32-in. plates. As regards the side framing, it comprises six pressed-steel posts on each side of the car made from ¼-in. plates. These are 18-in. wide and 3½-in. deep. In addition to these there are eight 3-in. x 3½-in. wooden side posts to which is nailed the inside lining. The end posts for the plain end construction are pressed from ¼-in. plate and are 7¾ in. wide by 3¾ in. deep. The corner posts are of wood. The side plates are 4-in., 10.3-lb. Z-bars, to which are riveted the side sheathing and the roof sheets.

Two designs of roof are permitted.

The tentative specifications for the general type of United States standard cars are published in the *Railway Age* for March 29 and April 5. These cover seven types of bodies for box, hopper and gondola cars and three types of trucks. They are quite extensive and cannot be reproduced here because of lack of space.

War Department Bureau Created to Pass Upon Plans of Inventors

The following statement is authorized by the War Department:

In order to secure prompt and thorough investigation of inventions submitted to the War Department, an "Inventions Section" has been created as an agency within the General Staff. All inventions of a mechanical, electrical, or chemical nature submitted to the War Department for inspection, test, or sale are now considered by this section.

Inventions may be sent by mail or may be submitted in person, accompanied by written descriptions or drawings. They go first to an examining board having technical knowledge of the classes of inventions they handle, whose investigations determine whether the inventions have merit. Those with merit are referred to the Advisory Board, which determines in

each case whether it should be put in the hands of some of the numerous testing and developing agencies, or if it should go to one of the staff or supply departments for test and consideration of its adoption, and final acquirement of title if such action is desirable.

When completed the board will have twelve to fifteen members to cover fully all of the various technical problems which may come before it.

Any persons desiring to submit an invention for consideration, test, sale, or development should do so by letter, giving in order the following information: Name and object of the invention; any claim for superiority or novelty; any results obtained by actual experiment; whether the invention is patented; whether remuneration is expected; whether the invention has been before any other agency; whether the writer is owner or agent; the number of inclosures with the letter. A written description and sketches or drawings of sufficient detail to afford a full understanding of the cases should also be submitted. Should the invention be an explosive or other chemical combination, the ingredients and processes of mixture should be stated.

The Inventions Section will not bear the expense of preparation of drawings and descriptions, nor advance funds for personal or traveling expenses of inventors.

Any matter submitted will be treated as confidential. The inventor will be notified of each step taken during the investigation of his invention. All communications should be addressed: Inventions Section, General Staff, Army War College, Washington, D. C. (*Official Bulletin*, May 13, 1918, p. 3)

Testing the Relative Strengths of Riveted and Welded Parts of a Ship's Hull

The purposes and possible benefits of the ship-welding test being conducted by the Emergency Fleet Corporation at the Central Shipbuilding plant, at Newark, N. J., under the direction of Arthur J. Mason, are outlined in a report made to Charles Piez, vice-president of the corporation, by Mr. Mason. The report follows:

The committee of which Prof. C. A. Adams is chairman has been enlarged, as instructed, and is active in bringing to bear all the knowledge and apparatus available, about which, no doubt, reports will come to you directly from time to time. I am a member of that committee and continue in active touch with it and rely on it for technical knowledge.

Electric welding in its various phases has for years been employed in shipyards and in the arts generally, but for a number of reasons the work has been confined to odd jobs and repairs. The proposal to extend its use to the major part of ship construction has met with gratifying approval from the shipbuilder. It remains for us through this large test to demonstrate its economy in time and money and its adequacy to build a stanch ship.

The purpose of this test is to demonstrate these advantages, to do it in such a way that all may see and contribute, and finally to test the structure itself so completely that there will follow a heart-whole and unanimous belief in the method.

The test itself will take the form of building part of a hull at the Federal Shipbuilding plant, Newark, N. J.

It has been necessary to design a ship to suit the material available, without encroaching on that needed for the regular ship construction at the plant. This has been done. The hull will have the outline, dimensions and strength conforming to the ships the Federal company is building.

It has been thought best to conduct the work at a site apart from the shipways, so as not to interfere with that program.

A 10,000-ton ship, costing $2,000,000, now costs but $70,000 to rivet. It must be plain that if electric welding only promises to modify this amount, no very substantial gain offers.

Splendid benefits we all feel do offer themselves in the possible change in the whole régime of shipbuilding. Our test has in view abolishing, or greatly diminishing—

1 The railroad journey from rolling mill to fabricating plant, when the latter is not at the shipyard
2 The template-makers' work
3 The markers' work
4 The punching
5 Much of the work of the fitters and bolters, who flog and pull the pieces to fit on the ways.

There lies in the above items an excellent likelihood to save a month's time in construction and a saving of no less than $40 a ton in the cost of steel structure, at least $100,000 a hull on a 10,000-ton vessel.

Briefly the program is to assemble a hull rapidly by spot welding, tacking the ship together much as a tailor bastes his work in assembling a suit of clothes. The structure then becomes a house favorable for work in all weather and at night in which the completion of the ship may go on.

After the material is thus assembled and fastened with spot welds so that it is sufficiently strong to hold its shape, the work is completed by arc-welding all seams to insure strength and render the work watertight. Roughly we expect the spot welds to be about ten inches apart.

The severe tests of strength contemplated needed about 300 piles.

One-quarter of the structure will be riveted; the other three-fourths welded so that the tests of strength will afford a basis of comparison.

Electric welding offers a great field for lightening a ship. In this design various views of this opportunity will be tried out. The field here is very great—ultimately ten per cent of the steel may be eliminated.

Only a fifth of the men on a hull are riveters. The spot-weld yoke will forthwith pull the parts to place with much more vigorous agency than flogging and pulling to place by numerous bolts, now done by the other four-fifths.

The problems of fitting in place the parts of a hull are almost wholly problems arising out of the necessity to make a number of little holes in a plate made by one man at one time and place fit a number of little holes made by another man at another time and another place.

Once all holes are left out of the material, all parts fit. The creeping and kindred problems so perplexing to the shipbuilder disappear. Every plate becomes a closer. Every plate justifies itself.

An adequate system of testing the work when done is under consideration.

The primary test will consist of filling the hull with water and shifting the points of support under continual and close scrutiny, as one-quarter of the whole will be riveted in the normal manner. There will be always a gage of comparison with that portion which is welded. Likewise there will be a chance for comparison of the two forms when subjected to abuse, by bumping with rams and in various other ways. (*Emergency Fleet News*, April 29, 1918, p. 11)

Interest in Use of Steam Meters in England

Shortly after the inauguration of the Government department of scientific and industrial research (about 18 months ago) it was decided to form a society, to be called The Brad-

ford Association for Engineering Research, to which all the leading firms of mechanical and electrical engineers in the district willingly became subscribers. A committee of representatives of these firms was formed, with Mr. Frank Wigglesworth, of Messrs. Frank Wigglesworth & Co. (Ltd.), engineers, Nab Wood, Shipley, as honorable secretary. From a number of subjects submitted for inquiry the first one selected was The Flow of Steam in Pipes, with Special Reference to Steam Meters. The Government advisory council was approached with a request for assistance in the form of a grant, and several interviews have taken place with the authorities in London, whose sanction to the project has been given on the understanding that half of the cost of the research will be subscribed locally.

The need for a reliable steam meter is very great, especially where steam is used for heating and boiling, as in dye works, bleaching works, chemical works, soap works, paper mills, etc. It is well known that a large proportion of the steam is wasted in ways which cannot easily be detected, and which have come to be regarded as inevitable. A reasonably accurate steam meter would help materially to reduce these losses. During the last ten years several forms of meter have been brought out, and have met with more or less success. They are all, however, of American or German origin, and hitherto nothing has been done in Great Britain either in the way of research or in the manufacture of an instrument of British origin. The foregoing is from the *Yorkshire Observer* of April 5, 1918, in regard to a report to be issued by the Bradford Association for Engineering Research, on the Flow of Steam in Pipes, with Special Reference to Steam Meters. (*Commercial Reports*, no. 100, April 29, 1918, p. 389)

Pitch as a Steam-Boiler Fuel

Pitch is composed chiefly of free carbon and of hydrocarbons which become volatile on heating above 400 deg. cent. Under correct conditions it can be burned completely to carbon dioxide and water vapor. The elementary analysis of pitch shows it to contain from 90 to 94 per cent of carbon and from 4 to 4½ per cent of hydrogen. The "approximate" analysis, however, gives a better indication of its composition and of difficulties that may be expected when burning it upon a commercial scale, for when it is raised to a red heat in a platinum crucible two-thirds of it passes off as volatile matter, and only one-third remains behind in the crucible in the form of pitch coke. When tested in the bomb type of calorimeter pitch shows a calorific value of 15,600 B.t.u. gross or 15,000 B.t.u. net; that is, it possesses a heat value equal to that of the best Welsh steam coal. If supplied with sufficient oxygen and raised to a temperature sufficiently high to secure complete combustion it is therefore a valuable fuel, and the problem of its efficient utilization under steam boilers resolves itself into one of providing the necessary conditions inside the boiler furnace.

Two difficulties are met with when burning pitch under industrial conditions in ordinary grates and furnaces, both due to certain physical characteristics of the fuel. In the first place, it softens at a comparatively low temperature and passes into the semi-fluid state by almost imperceptible stages. In the second, the hydrocarbon gases which form two-thirds of the weight of the fuel when heated come off with great rapidity when once the molten pitch has attained the temperature necessary for gasification. At a moment, therefore, when a great increase in the air supply is necessary, the molten pitch is flowing into the air spaces between the firebars of the furnace, and is closing these, with disastrous results for the proper combustion of the evolved gases.

As regards trials of pitch for steam-raising purposes carried out in London, the fuel expert of the London Coke Committee, Mr. E. W. L. Nicol, soon after the outbreak of the war began to experiment with this use of pitch, since it was seen that if a mixture of coke and pitch could be burned with a fair measure of efficiency under boilers, a better market would be created for these two by-products of the gas-making and tar-distilling industries, and incidentally the demand for ordinary coal would be reduced. A special type of firebar was designed by Mr. Nicol for the purpose, its chief feature being that it contained a channeled passage leading to a spoon-shaped trough, in which the molten pitch collected and remained while the volatile gases were distilled. Steam jets were employed with this bar in order to supply the heated air necessary to mix with and consume the large volumes of hydrocarbon gas produced as the solid pitch fed on the flat and cooler end of the bar melted and flowed down into the cavity at the center, where the heat of the surrounding incandescent fuel gasified it. These "pitch bars" could be sandwiched, in any number required, between the ordinary bars of the furnace grate, the latter being removed to make place for them. The pitch coke that collected in the center trough of the bars, after the gases were distilled, was cleared out from time to time and burned at the rear of the furnace on ordinary firebars. The trials of these special pitch bars were suspended in 1917 owing to the increase in the price of pitch in London, but so far as they went they proved that pitch can be burned with coke in this way without excessive nuisance from smoke.

Among new forms of "atomizer" for very thick and viscous liquid fuels, patent No. 101444 of 1916, granted to H. Bolling, of Christiania, describes a method of melting the pitch by aid of superheated steam, while German patent No. 300301 of 1916, granted to H. Sieger, describes a more complicated form of gas-heated vaporizer for liquid fuels, in which the principle of flameless combustion is employed to gasify the fuel before it is injected into the combustion chamber of the furnace or boiler. Another German patent, No. 299864 of 1915, makes use of an electric resistance coil for preheating, and of a pilot jet of light oil for ignition purposes. All these devices, of course with some modification, might be applied to the atomization of pitch, and lest it be thought that only foreign engineers are devoting their attention to the problem, it may be stated that English inventors are already at work upon it, and that very shortly an English design of liquid fuel burner for use with pitch will be placed upon the market. (*The Times Engineering Supplement*, no. 522, April 26, 1918, p. 84)

Products Derived From Corn Cobs

In a paper read before the New York section of the American Chemical Association at its regular meeting last Friday night, Dr. F. B. LaForge of the Bureau of Chemistry said that with the American corn crop estimated at 3,000,000,000 bu., which means probably about the same amount of corn cobs now going to waste, the United States Bureau of Chemistry has discovered practical and probably commercial methods whereby 37½ per cent of their substance can be converted into glucose, 30 per cent into usable mucilage, and 5 per cent into xylose, in addition to much new baking-powder material and a large quantity of acetic acid, with probably other valuable by-products yet to be discovered.

According to Dr. LaForge, there are four principal materials which may be prepared successfully from corn cobs;

about 30 per cent of a gum resembling dextrine but composed largely of polymerized xylose, instead of glucose, as in the case of dextrine. This material should be useful as an adhesive in the paper-box industry, for bill posting, wall papering, labeling, etc. It would be extremely cheap, and as far as its sticking qualities are concerned, it is probably about the equal of the dextrine preparations now commonly used. Its use would make possible an enormous saving of the foodstuffs now used in making dextrine and other starch preparations.

From 5 to 6 per cent of the pentose sugar xylose is another product. This sugar has been up to now a comparatively rare substance, but one and possibly two uses for it have been tried out or are being worked out and will be described later.

Acetic acid is obtained in the preparation of xylose in amounts which, at its present price, would be a very great source of profit in working up large amounts of cobs and at all times would be an important by-product. (*Journal of Commerce*, May 13, 1918, pp. 15 and 17)

Rochester Plan for Supplying Shipyard Labor

As the result of a conference between the Merchants' Association and representatives of the New York shipyards, the idea underlying the "Rochester Plan" for supplying shipyard labor may be adopted in New York. The essential feature of this plan is a central employment bureau created and operated by all the important Rochester, N. Y., industries, through which they secure all their labor. The central bureau becomes a labor-recruiting organization for all Rochester factories and endeavors to prevent other cities from inducing Rochester workmen to leave Rochester. It guarantees that the most essential Rochester plants will be furnished with the necessary skilled workmen even if that necessitates a voluntary draft on other factories, and it seeks to make labor conditions in Rochester plants such that the workmen will be properly treated, satisfied and efficient. In other words, Rochester has endeavored to place the entire community squarely behind the plants working on war orders.

It was the opinion of most of those present at the conference that the "Rochester Plan" is essentially a community plan which could not be adopted successfully in a large and complex metropolitan district, but that the underlying idea of the plan, namely, that of centralized effort to increase the shipyard labor force and to adapt mechanics to shipyard work, is possible and desirable.

In essence the "Rochester Plan" consists of a coöperative employment bureau organized, financed and operated by the important industrial plants of the city, and in charge of a very high-grade man having extensive experience in industrial-employment problems. The chief function of this employment agency of the manufacturers is to obtain a sufficient number of workmen to meet the requirements of all factories of the city. All additional workmen of plants operating under this agency are secured through it. In obtaining labor, the principle is followed that the demands of plants working on Government war supplies must be met first, even if this means taking skilled men from those less-essential plants supporting the Central Employment Bureau. In fact, there has already been a voluntary industrial draft to obtain certain skilled workmen needed by the plants operated for the Government.

The Central Employment Bureau has not displaced the regular employment agencies, but works through them as much as possible. It also seeks to bring workmen to Rochester from communities where a supply of skilled labor is available. In doing this it represents industrial Rochester rather than individual plants. It does not stop at merely bringing the workmen to the city, but it distributes them to the various plants according to their needs and to the type of workmen, aids in getting the workmen properly housed in a district near the plants, and in general endeavors to make the workmen contented and satisfied with Rochester.

So called "stealing the labor" is eliminated. However, it is realized that much of the additional labor needed by the war industries of Rochester is already there and must be shifted from less-essential plants. The Central Employment Bureau has proved to be a valuable agency for transferring labor from industry to industry. The industry which must lose its labor to some extent to more essential plants is aided in diluting its remaining labor and thus in continuing efficient production, while at the same time it is protected from losing a proportion of its labor force so large that it becomes impossible to dilute the remainder successfully. On the other hand, through the Central Employment Bureau the essential plants are constantly studying the problems of training inexperienced workmen and diluting their own skilled force so as to expand production with the least possible harm to the other industries of the city. (*Journal of Commerce*, May 3, 1918, p. 3)

Pig-Iron Interests Form Association

The production of pig iron is so far short of the heavy demand for it that preference has had to be given in making allotments to certain concerns holding urgent Government contracts. There has also been some controversy as to what constitutes the base price for determining the differentials, and there has also been considerable controversy between the trade and the War Industries Board on the subject of the right of sellers to collect commissions from consumers.

To enable these differences to be brought to the attention of the Washington authorities in a representative and official way, and to arrive at a settlement of all such questions as may arise between the Government and the trade, an organization known as the Merchant Pig Iron Distributers' Association has been organized at a conference held in Philadelphia.

The president of the new association is W. S. Pilling, of Philadelphia, and the secretary is W. W. Hearne, of the same city. The membership is not yet complete, but it will include all representatives of all the leading distributers of pig iron in the United States. It has been felt by members of the industry that they should be entitled to greater consideration when matters of vital importance to the trade were decided at Washington. (*Journal of Commerce*, April 23, 1918, p. 3)

The spring meeting of the National Machine Tool Builders' Association was held at Atlantic City, May 16 and 17. The meeting was devoted mainly to subjects relating to the war, the leading feature being an address by Isaac F. Marcosson, war correspondent of the *Saturday Evening Post*, on the Business of War. Addresses more technical in nature were given by H. W. Dunbar, of the Norton Grinding Company, on Safety Devices on Machine Tools, by H. E. Miles, on Women in Industry, and one by George Merryweather, relating to work of the Machine Tool Section of the War Industries Board.

Of the business transacted, the most important dealt with the production of heavy machine tools such as required for the work of the Ordnance Department, both with regard to the design of the machines and the apportionment of the tools in a way to secure the maximum production necessary to meet the present emergency of the Government.

U. S. BUREAU OF STANDARDS

COMPARATIVE TESTS OF CHEMICAL GLASSWARE, Percy H. Walker and F. W. Smither. Beakers of Kavalier glass, and beakers and flasks of Macbeth Evans Glass Co., Pyrex, Jena, Nonsol, Fry and Libbey glasses were tested for chemical composition, coefficient of expansion, refractive index, strain, behavior on repeated evaporation, resistance to heat and mechanical shock, and to solution in a variety of chemical reagents.

No conclusions as to the relative values of the different wares can be drawn from the chemical analyses, though these analyses may be useful by enabling the chemist to choose a glass which will yield no objectionable ingredient to the solutions used in any particular piece of work. The coefficient of expansion of all the glasses is low and is unusually so in the Pyrex ware. All the ware shows more or less strain, but it was disappointing to find that no information as to liability to break under sudden changes in temperature or mechanical shock could be obtained by an examination for strain. All the ware tested showed good resistance to repeated evaporation of a salt solution. While the heat and mechanical shock tests were performed on too small a number of pieces to justify positive conclusions, they indicated that the Kavalier and M. E. G. Co. ware are less resistant than Jena, Nonsol, and Fry wares, the Libbey somewhat more resistant and the Pyrex ware distinctly more resistant. The Kavalier ware is unsatisfactory as regards solubility in water; all the other wares appear satisfactory in this respect. All the ware is resistant to acids, Kavalier is least resistant to carbonated alkalies, Pyrex more resistant than Kavalier but less resistant than the others. Kavalier and M. E. G. Co. wares are more resistant to boiling caustic alkaline solutions than the others but the differences are not great. All the glasses are much attacked by evaporating caustic alkalies. Ammonia water has about the same effect as mixtures of ammonium chloride and sulphide. The authors are of the opinion that considering all the tests each of the American wares is superior to the Kavalier and equal or superior to the Jena ware. (*Technologic Papers of the Bureau of Standards*, no. 107)

EFFECT OF THE SIZE OF GROG IN FIRECLAY BODIES, F. A. Kirkpatrick, Assistant Physicist. In those industries which use crushed and ground raw materials in forming bodies by means of a cementing action of some sort the size of the particles plays a most important rôle. This may be in many instances the main factor controlling the desired properties in the body. This is nowhere more true than in the ceramic industries, where in compounding bodies the manufacturer is compelled to use materials from the size of pebbles down to the dispersoid and emulsoid (colloidal) states. All present evidence tends to show that in disperse systems the size of particles which we can not now measure has as much effect upon the properties of certain materials as have the larger sizes which we are able to measure. In no other way is it possible to account for the great differences in cementing power exhibited by fine-grained bond clays and other fine-grained materials. In practice the cementing action takes place at temperatures from zero to that of the electric arc, depending upon the nature of the process, and is due to many different chemical reactions. In the present work the bonding power of mixtures composed of raw clay and calcined clay is determined after these bodies have been heated to 110 deg. cent. and to 1250 deg. and 1300 deg. cent.

The control of the strength of raw fireclay bodies is a difficult matter into which enter a number of factors. Those which are directly connected with the size of grog are size of the body, cracks formed in drying, density or porosity, and size of grain of the clay.

If the grog is too large for the size of body used, the conditions of bond are different than for smaller grog. Small cracks may or may not form in drying. The general rule in ceramic bodies is that strength increases with decrease of porosity, but this factor may be overruled by others. In series 4 of the tests carried out, however, the rule holds. As shown in connection with series 5 and 7 the size of grain of the bond clay also affects the strength of the body. In regard to the grog, aside from other considerations, the following condition is necessary for highest strength. The mixture of sizes must be such that the smaller particles fill the voids between the larger, giving maximum density. The proper proportions may be predicted qualitatively from the ratio of sizes, but can be determined accurately only by experiment.

The strongest raw bodies were those in series 4 and 7. In series 4 these had the following limits of grog composition: 25 to 66⅔ per cent, 20 to 40 grog; 0 to 25 per cent, 40 to 80 grog; and 33⅓ to 66⅔ per cent, 80 to dust grog. In series 7 the strongest bodies were those containing the greatest percentage of 80 to dust grog.

The control of strength in the burned state proved to be not at all difficult. For all bodies used the modulus of rupture was found to increase with increase of surface factor. The relation was represented by means of straight lines except that the lower portions of some of the curves representing large-sized grog were of parabolic form. The rate of increase of strength increased with the temperature of burning, due to the more rapid rate of solution of the finer particles at the higher temperatures. The porosity at cone 12 varied much the same as in the raw bodies and had little relation to strength. The strongest bodies were those in series 4 (20 to dust grog). No relation was found between strength in the raw state and in the burned state.

In the quenching tests from 600 deg. cent. and 1000 deg. cent., mixtures of the larger sizes of grog gave the more resistant bodies. (*Technologic Papers of the Bureau of Standards*, no. 104)

National Research Council as a Permanent Body

The National Research Council was organized in 1916 at the request of the President by the National Academy of Sciences, under its congressional charter, as a measure of national preparedness. The work accomplished by the council has demonstrated its capacity for larger service, and the National Academy is now requested by executive order of President Wilson to perpetuate the National Research Council, the main duties of which shall be as follows:

1 In general, to stimulate research in the mathematical, physical, and biological sciences, and in the application of these sciences to engineering, agriculture, medicine, and other useful arts, with the object of increasing knowledge, of strengthening the national defense, and of contributing in other ways to the public welfare;

2 To survey the larger possibilities of science, to formulate comprehensive projects of research, and to develop effective means of utilizing the scientific and technical resources of the country for dealing with these projects. (*Official Bulletin*, May 14, 1918, p. 1)

REVIEW OF ENGINEERING PERIODICALS

SUBJECTS OF THIS MONTH'S ABSTRACTS

PENETRATION OF CARBON IN CASE-HARDENING
HEAT CHANGES IN COLD-WORKED AND TEMPERED CARBON STEEL
COMBUSTION OF NORTH DAKOTA LIGNITES
ENTROPY DIAGRAM FOR GASOLINE
THERMAL PROPERTIES OF GASOLINE CARBOCOAL
BURNING OF PITCH AND CREOSOTE MIXTURES
DETONATOR IGNITION IN HEAVY-OIL ENGINES
AIR-TURBINE-DRIVEN GRINDING WHEELS
CONCRETE METAL-PLANING MACHINES
MICROMANOMETERS, RECENT DEVELOPMENTS
ERICHSEN TEST ON ALUMINUM SHEETS
VALUE OF *g* IN ENGINEERING AND PHYSICS
SPRINGS FOR OSCILLATING MASSES, DESIGN
GERMAN TIRE SUBSTITUTES
WASTE-HEAT BOILERS FOR MALLEABLE FURNACES
FEED ARRANGEMENTS FOR TURBINES WITH SUPERCRITICAL STEAM VELOCITY
TEMPERATURE CONTROL FOR SUPERHEATED STEAM
STEAM-TURBINE DISKS WITH SHRUNK-ON BOSSES
STEAM-TURBINE DISKS, DESIGN
NOTCHED-BAR EXPERIMENTS

For Articles on Subjects Relating to the War, see Aeronautics, Engineering Materials, Machine Tools, Munitions, Varia

Aeronautics

AVIATION AND THE WAR, C. F. Lee. *Journal of the Washington Academy of Sciences*, vol. 8, no. 8, April 19, 1918, pp. 225-232. Discussion of the training of aviators, with special reference to "stunt" and formation flying; also some remarks on the classification of machines.

THE SOPWITH TRIPLANE. *Flight*, no. 484 (vol. 10, no. 14), April 4, 1918, pp. 361-365, illustrated.

THE EFFECT OF AN AIRPLANE RUDDER IN FLIGHT, Karl H. White. *Aviation and Aeronautical Engineering*, vol. 4, no. 7, May 1, 1918, pp. 448-449, 4 figs. Describes methods for finding the moments about the center of gravity of airplanes of different length due to rudders of different aspect ratios under varying angles of deviation. The results are expressed in the form of tables and curves.

THE GALLAUDET AIRSCREW PROPULSION DESCRIBED. *Aviation and Aeronautical Engineering*, vol. 4, no. 7, May 1, 1918, pp. 454-456, 4 figs. Description of the construction of an airplane fitted with a pusher propeller without using an attachment of the tail planes by means of outriggers or tail booms, the presence of which generates a certain amount of parasite resistance; taken mainly from a United States patent.

Engineering Materials (See also Measurements)

DEFECTS IN STEEL INGOTS AND FORGINGS, S. W. Werner and Gordon Spencer. *Iron and Steel of Canada*, vol. 1, no. 3, April 1918, pp. 110-116, 13 figs.

LA FABRICATION DES BRIQUES DE SILICE, H. LeChatelier and B. Bogitch. *Bulletin et Comptes Rendus Mensuels de la Société de l'Industrie Minérale*, Tome 12, 3rd issue of 1917, pp. 49-97, 14 figs. Data on the manufacture of silica bricks.

LES ALLIAGES D'ALUMINIUM ET DE MAGNESIUM, Jean Escard. *Revue Scientifique, Industrielle & Commerciale des Métaux et Alliages*, no. 11, November-December 1917, pp. 1-3. Discussion of various aluminum-magnesium alloys giving, among other things, tables of their melting points and indicating their physical and chemical characteristics and methods of preparation.

L'EMPLOI DE LA PRESSION PLASTIQUE DU PLOMB, M. Lunet. *Le Génie Civil*, tome 72, no. 14, April 6, 1918, pp. 236-238, 11 figs. Description of methods of manufacture of stamped metal articles under lead pressure. An abstract of this article may appear in an early issue of THE JOURNAL.

COOLING RATE AFFECTS STEEL CASTING DESIGN, J. G. Fletcher. *The Foundry*, vol. 46, no. 309, May 1918, pp. 201-204, 2 tables.

THE PENETRATION OF CARBON, Howard Ensaw. Discussion of various methods of case-hardening and of the penetration of carbon. Among other things a chart showing penetration of carbon is given, with percentages of carbon as ordinates and degrees of hardness as abscissæ.

The selection of suitable boxes for carburizing is discussed, the writer recommending, as a most suitable material in most cases, steel boiler plate $\frac{3}{8}$ or $\frac{1}{2}$ in. thick, which can be made with welded joints and will last well.

The sizes of the boxes employed depend to a great extent on the nature of the work being done, but care should be exercised to avoid putting too much in one box, as smaller ones permit the heat to penetrate more quickly, and one test piece is sufficient to give a good indication of what has taken place. If it should be necessary to use larger boxes it is advisable to put in three or four test pieces in different positions to ascertain if the penetration of carbon has been satisfactory in all parts of the box, as it is quite possible that the temperature of the muffle is not the same at all points, and a record shown by one test piece would not then be applicable to all the parts contained in the box. It has been found that the rate of carbon penetration increases with the gas pressure around the articles being carburized, and it is therefore necessary to be careful in sealing up the boxes after packing. When the articles are placed within and each entirely surrounded by compound so that the compound reaches to within 1 in. of the top of the box, the lid, which should be a good fit in the box, is then to be pressed on top of this, and another layer of clay run just below the rim of the box on top of the cover.

A mixture of fireclay and sand will be found very satisfactory for closing up the boxes, and by observing the appearance of the work when taken out we can gage the suitability of the methods employed, for unless the boxes are carefully sealed the work is generally covered with dark scales, while if the sealing is properly done the articles will be of a light gray.

By observing the above recommendations reliable results can be obtained and we can expect uniform results after quenching. (*American Machinist*, vol. 48, no. 18, May 2, 1918, pp. 755-756, 1 fig., 1 chart)

ACID OPEN HEARTH STEEL INVESTIGATION, T. D. Morgans and F. Rogers. *The Blast Furnace and Steel Plant*, vol. 6, no. 5, May 1918, pp. 216-217.

INFLUENCE OF TEMPERING AND COLD-WORKING ON CARBON STEEL, F. Cloup. In studying the heat changes brought about in annealing cold-worked or heat-treated steel the writer has observed a complete parallelism between these two phenomena. The experiments were carried out in accordance with the differential method of Sir Roberts-Austen and with photographic recording by the double galvanometer of Saladin and LeChatelier.

The following results were obtained:

1 The curve of the rise of temperature in steels which have previously undergone cold-working or heat-treating has in all cases at about 400 deg. cent., a singular point characterized by an evolution of heat.

2 The change of state which takes place at this temperature reaches completion only quite slowly, both in the case of heat-treated steel and in the case of cold-worked steel. Thus, two samples of the same steel, 0.12 per cent carbon, of which one has been tempered from 1000 deg. by immersion in water at 15 deg. and the other cold-worked, then both heated to 640 deg. for a period of 25 min., still show, during the second reheating, the singular point at 400 deg. cent. After a heating for twelve hours at 600 deg. cent. the transformation is completed and a new curve of heating does not show any irregularities.

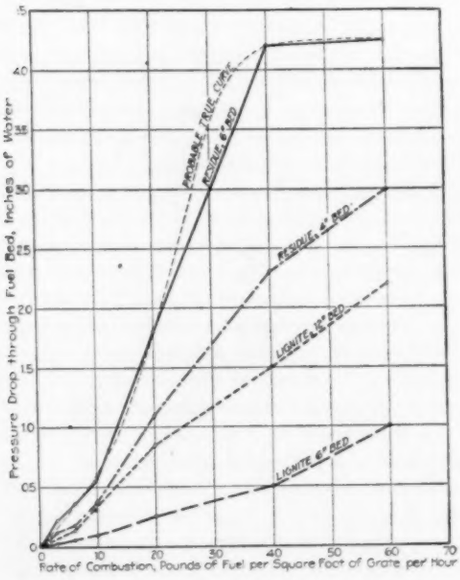

Pressure Drop through Fuel Bed, Inches of Water
Rate of Combustion, Pounds of Fuel per Square Foot of Grate per Hour
PROBABLE TRUE CURVE
RESIDUE 6" DEEP
RESIDUE 4" DEEP
LIGNITE 6" DEEP
LIGNITE 4" DEEP

FIG. 1 DRAFT REQUIRED FOR LIGNITE

3 This change of state is irreversible. The curves of cooling of both heat-treated and cold-worked steel have the perfectly regular appearance. This transformation must be accompanied by a sudden change of volume. Since the metal is not malleable at 400 deg. cent., it becomes subject to internal stresses which produce a breakdown of equilibrium. If, then, by external work, such as hammering, these internal stresses are still more intensified the most favorable conditions are created to cause rupture of material, which is actually quite frequent when cold-worked steel is heated and subjected to mechanical working at about 400 deg. cent. (*Trempe et Écrouissage des Aciers au Carbone*, F. Cloup, presented by Henry LeChatelier. *Comptes Rendus hebdomadaires des Séances de l'Académie des Sciences*, tome 166, no. 10 (March 11, 1918), pp. 415-416)

JUNK PILE TRANSFORMED INTO GOLD, George H. Manlove. *The Iron Trade Review*, vol. 62, no. 19, May 9, 1918, pp. 1173-1176, 3 figs., 1 chart. Discussion of the changes which the present scarcity of raw materials produced in the handling of metal scrap.

BIBLIOGRAPHY OF THE PHYSICAL PROPERTIES OF COPPER, Paul D. Merica. *Metallurgical and Chemical Engineering*, vol. 18, no. 8, April 15, 1918, pp. 409-415.

Foundry

HOW GUN LATHE CASTINGS ARE MADE, H. Cole Estep. *The Iron Trade Review*, vol. 62, no. 17, April 25, 1918, pp. 1045-1051, 15 figs.

ESTIMATING THE WEIGHTS OF CASTINGS RAPIDLY, Warner Hathaway. *The Foundry*, vol. 46, no. 309, May 1918, pp. 210-212, 4 tables.

Fuel and Firing

COMBUSTION OF NORTH DAKOTA LIGNITES, WITH SUGGESTIONS FOR DESIGN OF FURNACES, Henry Kreisinger, Mem.Am. Soc.M.E. An article published by special permission of Dr. H. Van Manning, Director of the United States Bureau of Mines.

In the ordinary furnace with horizontal grate the lignite of North Dakota is very difficult to ignite, and even after combustion has been started troubles are apt to occur.

A special furnace was designed and constructed to satisfy the basic requirement of burning lignite and its carbonized residue. The essential features of this furnace, designed with particular regard to house-heating purposes, are shown in Fig. 3.

In this furnace rapid ignition is obtained by the rear arch, which turns the hot gases and flames back over the fuel bed. Thus, the incoming fresh fuel is heated not only by conduction through the fuel and radiation from the arch, but mainly by convection when coming in contact with the hot gases and flames from the already burning fuel.

Further, to heat lignite having 35 per cent moisture to ignition temperature takes more than twice as much heat as is required to heat bituminous coal containing 10 per cent of moisture. It is therefore difficult, if not impossible, to supply enough heat by radiation from the ordinary front arch to ignite the lignite, and another factor of heat supply must be brought into action—in this case heat transmission of hot gases by convection. The grate is inclined and has wide horizontal air spaces, which can be easily kept open, permitting free flow of air through the grate. Additional air is admitted through the door for removing clinker at the lower end of the grate. As this air passes up between the arch and the fuel it scrubs against the surface of the fuel bed, and a large part of it is consumed in burning or gasifying the solid fuel, thus making it unnecessary to force all the air needed for gasification of the fuel through the fuel bed.

Experiments showed that the scrubbing action of additional air caused a rapid and rather complete oxidation at the surface of the fuel bed, indicated by the bright red heat, which was practically absent on the tests made in an ordinary furnace with horizontal grate. Thus there were two oxidation zones, one next to the grate and one at the surface of the fuel bed, probably with a small reducing zone between them. Because the air which enters through the cleaning door against a low resistance burns or gasifies solid fuel, higher rates of

combustion can be obtained than with ordinary or natural draft.

The air spaces in the grate are horizontal, and the inclination of the grate is such that the fuel is fed from the magazine down the grate by gravity, besides which the rate of feeding can be increased by a slight agitation or rocking of the grate bars. The gravity feeding can be used better with lignite than with most bituminous coals, because the fuel does not cake. The thickness of the fuel bed and, to some extent, the rate of feeding are controlled by the opening of the gate of the fuel magazine.

In the tests made with a draft of 0.1 to 0.15 in. of water, the lignite made a bright, red-hot fire, although the arch never was visible red-hot. When the lignite was broken to pieces not exceeding about two inches, the feeding of the fuel was nearly automatic, though with larger pieces the fuel had to be occasionally moved down by shaking the grate bars and by poking the large pieces through the magazine gate.

Slack, though present in considerable amount, did not seem to cause any particular trouble.

The principles embodied in the design of the furnace for house-heating purposes shown in Fig. 2 can be applied also to boiler furnaces as shown in Fig. 3. There diagram A suggests the design of an inclined step-grate boiler furnace. The fuel can be fed by gravity aided by hand regulation, or it can be pushed out of the magazine mechanically by a pusher plate. There should be as little air as possible entering through the coal magazine or through the plate in front of the coal magazine where the fuel is merely being dried and does not burn.

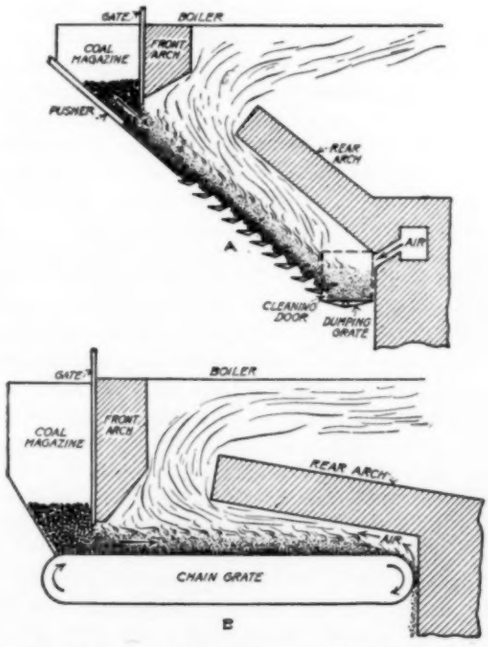


FIG. 2 EXPERIMENTAL HOUSE-HEATING FURNACE FOR LIGNITE

The completeness of combustion should be controlled by regulating the air admitted to the lower end of the grate and not by regulating the admission of air through the magazine.

Diagram B shows the application of the same principles to a chain-grate furnace. The diagram shows the grate in horizontal position, and it is believed that better results could be obtained if the top of the grate were inclined about 20 deg. to the horizontal. (*Power*, vol. 47, no. 18, April 30, pp. 608-612, 5 figs. *tpA*)

ENTROPY DIAGRAM FOR GASOLINE, Jean Rey. The utilization of gasoline in various apparatus as a vapor makes it desirable to have precise knowledge of the physical laws of its vaporization, preferably expressed as an entropy diagram.

The diagram presented here and plotted for ordinary gasoline of density 0.800 to 0.820 (for water = 1.000) has been developed from an investigation extending over many years.

The writer has found that the specific heat can be ex-

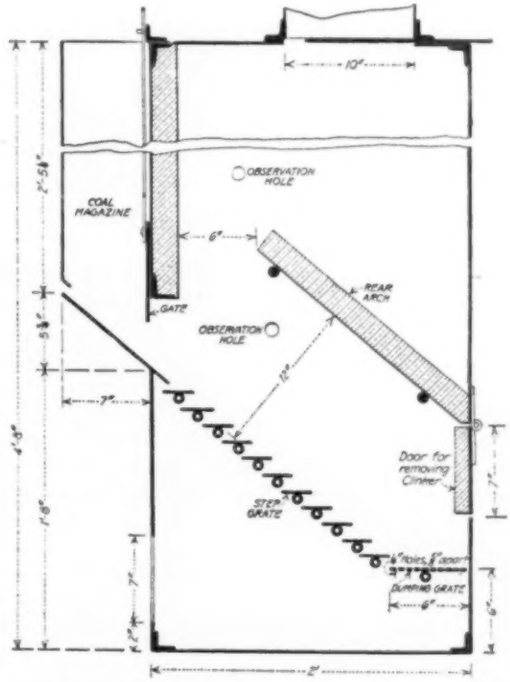


FIG. 3 PROPOSED ROUGH DESIGN OF FURNACE FOR BURNING LIGNITE UNDER BOILERS

pressed by the formula $C = a + bt$, where t is temperature in degrees centigrade. Measurements carried out on various gasolines of the same density have given as an average the formula

$$C = 0.50 + 0.0007t$$

As regards the heat of molecular vaporization, the writer has determined the value of L/T by comparison with various known organic liquids, namely, chloroform, acetone, sulphur and chloride of carbon.

In plotting the curves, giving L/T as a function of the absolute pressure, one finds that the average curve represents with sufficient approximation the value of the function for ordinary gasoline. This function has the form

$$L/T = a/T - b$$

where a and b are constants.

For the numerous series of organic liquids, the Bingham formula

$$L/T_0 = 17 + 0.011T_0$$

expresses the heat of molecular vaporization at the temperature T_0, which is the temperature of boiling at atmospheric pressure. It may, therefore, be used as a check for one point on the curve.

On the other hand, the writer has determined the curve of pressures of vapor of ordinary gasoline, which permitted him to plot the values of L/T for gasoline as a function of the

various temperatures, expressing these values as absolute pressures. In this way he obtained the following relation:

$$L/T = 15{,}160/T - 12.42$$

By dividing this expression by μ, the molecular weight of ordinary gasoline, one obtains the heat of vaporization per unit of weight in large calories r, or

$$r/T = 82.4/T - 0.0675$$

or

$$r = 82.4 - 0.0675T$$

The value 184 is a fairly close expression of the molecular weight for the various samples of gasoline tested. It is known that American gasolines are essentially expressed by the formula C_nH_m, where $m = 2n + 2$, while Russian gasolines correspond to formula C_nH_{2n}. Ordinary gasoline, which is nothing but a mixture, is expressed with sufficient exactness by $C_{12}H_{26}$.

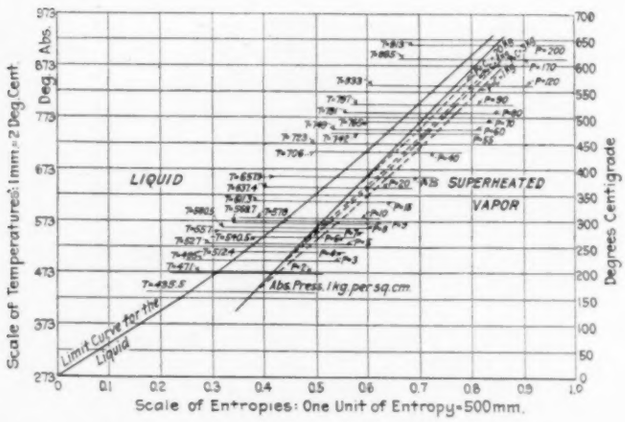

Scale of Temperatures: 1mm = 2 Deg Cent
Deg. Abs.
Degrees Centigrade
LIQUID
SUPERHEATED VAPOR
Abs. Press. / kg. per sq. cm
Limit Curve for the Liquid
Scale of Entropies: One Unit of Entropy = 500mm.

FIG. 4 ENTROPY DIAGRAM FOR GASOLINE

With these magnitudes established, one finds that the entropy of the liquid is given by the expression

$$S_{liq} = \int_0^T \frac{dq}{T} = \int_0^T \left[0.50dT + 0.0007(T - 273)\frac{dT}{T}\right]$$

$$= 0.3089L_0\left(\frac{T}{273}\right) + 0.0007(T - 273)$$

It is only necessary to add to this expression r/T in order to obtain the entropy of the saturated vapor, which is

$$S_{vap} = 0.3089L_0\left(\frac{T}{273}\right) + 0.0007T + \frac{82.4}{T} - 0.2586$$

It is by means of these formulæ that the diagram, Fig. 4, has been plotted. In order to verify the heat of vaporization, the writer used a special tubular boiler so designed as to make it possible to obtain pressure rapidly. After vaporization, gasoline condenses in a nest of pipes cooled by water from the outside. With this arrangement all that is necessary is to measure the amounts and the inlet and outlet temperatures of water and gasoline. The same apparatus was used for measuring the vapor pressures.

Certain precautions were necessary due to the fact that gasoline cannot be kept above a certain temperature without undergoing polymerization.

From the curve of vapor pressures one may deduce the following expression where T is the absolute temperature of boiling of gasoline expressed as a function of T_0, which is the absolute temperature of boiling of water at the same pressure:

$$T = 1.167T_0 - 0.641(T_0 - 273)$$

The various points in the entropy diagram reproduced here have been checked up to a pressure of 40 kg. (569 lb. per sq. in.). These checks have shown possible errors of from 1 to 2 per cent. The inspection of the diagram shows at once—

1 That the saturated vapor of ordinary gasoline is superheated through fall of pressure, and

2 That the heat of the liquid is always considerably higher than the heat of vaporization.

From these two properties, which are directly opposite to those of water vapor, it follows that when saturated vapor of gasoline is allowed to expand it is simultaneously superheated and produces mechanical work. If liquid gasoline under pressure is allowed to have part of its pressure removed it is partially vaporized, and if this lower pressure is maintained for a sufficiently long time, its vapor is superheated.

These properties are probably common to all the principal hydrocarbons. (*Comptes Rendus Hebdomadaires des Séances de L'Académie des Sciences*, vol. 166, no. 9, March 4, 1918, pp. 387-390, 1 fig., *teA*)

CONSERVING FUEL BY COAL BRIQUETING, F. Denk. *The Coal Industry*, vol. 1, no. 4, April 1918, pp. 129-131.

ECONOMY IN THE USE OF FUEL IN POWER STATIONS, Charles H. Parker. *Journal of the Boston Society of Civil Engineers*, vol. 5, no. 4, April 1918, pp. 163-185, 10 figs. An extensive paper devoted to the various features of power-plant operation having a bearing on fuel economy.

COMBUSTION OF COAL AND DESIGN OF FURNACES. *Power*, vol. 47, no. 17, April 23, 1918, pp. 596-600.

CARBOCOAL, Charles T. Malcolmson. Description of a series of experiments which are said to have resulted in the development of a process for the manufacture of a smokeless fuel from volatile coals and for the recovery and refinement of the coal-tar products derived therefrom. The process described is the invention of Charles H. Smith.

The essential features of this process are two distillations carried on at different temperatures; first of the raw coal and second of the raw briquets. The raw coal, after being crushed, is distilled at a relatively low temperature, 850 to 900 deg. fahr., and the volatile contents are thereby reduced to the desired point. The result of this first distillation is a large yield of gas and tar, and a product rich in carbon, termed semi-carbocoal. The semi-carbocoal is next mixed with a certain proportion of pitch obtained from the tar produced in the process, and this mixture is briquetted. The briquets are then subjected to an additional distillation at a higher temperature, approximately 1800 deg. fahr., resulting in the production of carbocoal, the recovery of additional tar and gas, and a substantial yield of ammonium sulphate.

The characteristic feature of the primary distillation is that it is continuous and that the coal is constantly agitated and mixed during the entire operation. This is accomplished by a twin set of paddles, which also advance the charge through the retort. By this means all portions of the charge are uniformly distilled, and by controlling the speed at which the charge moves through the retort, the distillation may be arrested at any desired stage. As only a partial carbonization is permitted in the primary distillation, the hard metallic cells characteristic of coke are avoided. The period of distillation is one to two hours, and the continuous retort has a carbonizing capacity of one ton of coal per hour.

In the subsequent distillation of the briquets all evidence of the pitch as a separate ingredient disappears. There is a

marked shrinkage in the volume of the briquet, with a corresponding increase in density, but no distortion of its shape. This distillation requires four to five hours, and is performed in an inclined, self-charging and self-discharging bench.

The carbocoal represents more than 72 per cent of the weight of the raw coal, the exact percentage depending upon the volatile content of the latter.

Carbocoal is dense, uniform in size and quality, grayish-black in color and is manufactured in briquet form in any size from 1 oz. to 5 oz. It is stated that it has been tested by the Long Island R. R., by the Pennsylvania R. R. at Altoona, the Carolina, Clinchfield & Ohio R. R. and by the U. S. Navy, and that it requires no greater draft than bituminous coal.

The analysis of carbocoal indicates from 1 to 3 per cent of moisture, from 0.75 to 3.50 per cent volatile matter, 82 to 90 per cent of fixed carbon and 7 to 12 per cent ash.

The article also describes in brief the recovery of tar and other by-products. (*Bulletin of the American Institute of Mining Engineers*, no. 137, May 1918, pp. 971-977, 3 tables)

THE BURNING OF PITCH AND CREOSOTE MIXTURES. Furnace and burner makers had not considered the burning of pitch mixtures until the subject was taken up by the Ministry of Munitions. The apparatus used was crude and of an elementary design. The use of creosote oil as fuel by the British Navy is likewise of comparatively recent origin.

Now, in order to increase the available supplies of creosote for naval purposes, steps were recently taken in Great Britain to limit its use in other directions by a system of licenses.

Admiralty supplies were increased to a point at which it appeared that further supplies could be drawn only from oil now consumed in the land furnaces. This is why the question of burning pitch, or rather pitch and creosote mixtures, was taken up in earnest, the successful use of such mixtures becoming a matter of great national importance.

The coöperation of furnace makers was first obtained, primary attention being given to those making use of oil for steam raising. Extensive trials were carried out with pitch and creosote mixtures, using modern pressure-jet systems. During these tests two companies successfully handled mixtures containing 60 per cent and 75 per cent of pitch and obtained boiler efficiencies of over 80 per cent working under natural-draft conditions. The fuel in the supply tank was kept at a temperature of about 130 deg. fahr. and was raised to 290 deg. fahr. at the burners, the fuel pressure being maintained at about 75 lb. per sq. in. Another company who used the White system for steam raising obtained a boiler efficiency of 82 per cent under forced draft from a mixture consisting of 70 per cent creosote and 30 per cent pitch, and are now using commercially in all their furnaces a mixture of 66.6 per cent creosote and 33.3 per cent pitch with satisfactory results.

Manufacturers of reheating, smelting and other furnaces were likewise induced to carry out experiments and have obtained promising results.

The chief difficulties in burning pitch and creosote mixtures lie in the handling and transport of the mixture and the presence of certain bodies in the pitch which necessitate increased attention to the burners. As regards transhipment of fuel, little difficulty has been experienced when the consumer has a railway siding available to take delivery and the tank wagons are equipped with steam coils.

The trouble experienced in burning certain mixtures is a very real one, and is due to the presence of free carbon, resinous matters or other foreign bodies contained in the pitch blocking up the burners and strainers. In practice it has been found that the pitch and any other liquid fuel which is rich in free carbon usually present difficulties in burning. It is recommended that consumers of pitch fuels should have their systems fitted with alternative strainers, so that when one strainer becomes choked up another may be operated while the first is being cleaned. (*The Engineer*, vol. 125, no. 3251, April 19, 1918, pp. 332-333, 1 fig.)

Hydraulics

VERTICAL-SHAFT WATER-WHEEL ALTERNATOR, H. D. Stephens. Description of the general construction of such alternators, the Kingsbury thrust bearing, methods of lubrication, and various schemes employed to drive the exciter. The informations refers mainly to the type built by the Westinghouse Electric and Manufacturing Company. (*Power*, vol. 47, no. 17, April 23, 1918, pp. 572-575, 7 figs., *d*)

Internal-Combustion Engineering (See also Fuel and Firing)

HEAVY-FUEL ENGINE WITH DETONATING IGNITER. Description of a heavy-fuel igniter working on the principle of detonation. The description is very incomplete because of legal formalities in connection with patent rights.

It is stated generally that the suction in the engine cylinder as the piston descends on the induction stroke is transmitted through a narrow passage in the foot of the detonator to its interior. Arrived at this point the suction opens a non-return valve inside the detonator and thence exerts its influence in the pipe connecting the detonator with the supplementary carburetor.

As regards the carburetion, it is stated that kerosene is merely broken up at the jet, the effective aperture of which is rendered rather smaller than usual by the insertion of a larger jet needle.

In addition to this there is a small auxiliary carburetor mounted above the cylinders and provided with two float chambers, one for gasoline and the other for a heavy fuel. Leading from this supplementary carburetor is a pipe with branches passing to a small receptacle known as a detonator screwed into each spark-plug hole.

On every induction stroke of the piston fuel is drawn both from the main carburetor into the combustion chamber and cylinder of the engine and from the supplementary carburetor along the appropriate branch pipe into the interior of the detonator mounted in the spark-plug hole of the same cylinder of the engine.

At the end of the induction stroke the suction ceases and the non-return valve in the top of the detonator closes under the influence of a light spring, so that the mixture in the detonator cannot escape back to the supplementary carburetor on the compression stroke of the engine piston. As this stroke proceeds, the main charge is compressed in the combustion chamber and a small proportion is forced up through the narrow opening in the foot of the detonator into the body of the detonator itself.

In the upper part of the detonator, however, the mixture from the supplementary carburetor is stated to lie compressed practically as a stratum on the top of that portion of the main charge which has been forced up into the lower part of the detonator. Into the side of the detonator is inserted a spark plug of ordinary design, the spark occuring on the completion of the compression stroke. It is said that the spark fires first of all the stratum of mixture drawn from the supplementary carburetor which ignites the heavier fuel in the detonator, and

then the flame rushes downward through the foot of the detonator into the engine combustion chamber. The heat intensity and area of the flame from the burning of the detonator charge are stated to be such that the temperature of the main charge instantly rises to a very high point, which makes its combustion practically perfect.

It is stated that the fuel drawn from the supplementary carburetor (gasoline) is only two per cent of the whole. (*The Autocar*, vol. 40, no. 1172, pp. 338-340, 1 fig., *d*)

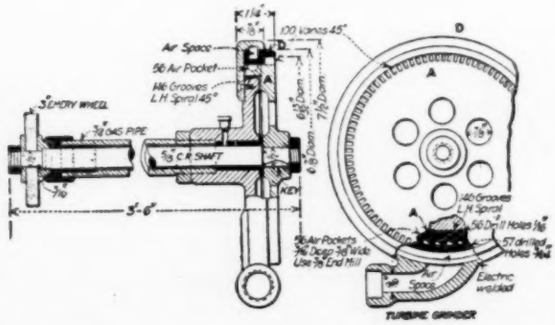


FIG. 5 AIR-TURBINE-DRIVEN GRINDING WHEEL

USE OF TAR OIL IN INTERNAL COMBUSTION ENGINES, A. W. H. Griepe. *The Gas Age*, vol. 41, no. 8, April 15, 1918, pp. 348-350, 7 figs.

NOTES ON THE GAS TURBINE, E. Boudot. *Aeronautics*, vol. 14, no. 232 (New Series), March 27, 1918, pp. 270-272, 3 figs.

EXHAUST PITS FOR LOW-COMPRESSION OIL ENGINES, L. H. Morrison. *Power*, vol. 47, no. 17, April 23, 1918, pp. 586-587, 3 figs.

KEROSENE CARBURETORS AND VAPORIZERS, George F. Crouch. *Motor Boat*, vol. 15, no. 7, April 10, 1918, pp. 30-34, 11 figs. Brief semi-technical description of kerosene carburetors and vaporizers on the American market, with special regard to their application to motor-boat engines. No data of actual tests are cited.

Machine Shop

TRAVAIL DU LAITON À FROID, Henri Bertin. *Le Génie Civil*, tome 72, no. 14, April 6, 1918, pp. 233-236, 6 figs. An interesting discussion of the cold-working of brass. An abstract will appear in an early issue of THE JOURNAL.

DRILL GRINDING, Edward K. Hammond. *Machinery*, vol. 24, no. 9, May 1918, pp. 825-830, 8 figs. An extensive practical discussion of the subject of drill grinding of interest to machine-shop men.

ELECTRIC FURNACES FOR HEAT TREATMENT, T. F. Baily. *The Iron Age*, vol. 101, no. 19, May 9, 1918, pp. 1199-1201, 2 figs.

Machine Tools

AIR-TURBINE-DRIVEN GRINDING WHEEL, W. J. Nene. Description of a machine designed especially for grinding welds. One of the greatest difficulties associated with electric welding of cast iron in the small shop is a tendency to leave the weld so hard as to be practically unworkable except by an abrasive wheel. The operator therefore has to have some quick and efficient means of working down these hard spots.

The machine described is simply an air turbine of special design, carrying an abrasive wheel on the end of its rotor shaft. The writer vouches for the efficiency of the machine and states that the turbine at 90 to 100 lb. pressure furnishes ample power to drive a 3-in. wheel at 3500 r.p.m., which is approximately correct for a wheel of this size.

The parts are made of mild-steel forgings, except the ring *D* and the bearings, which are of hard brass, and the ball races, which are of tool steel hardened and ground.

The compressed air enters the annular chamber marked "air space," Fig. 5; thence it flows through the air ports, that is, the fifty-seven 3/64-in. drilled holes, and impinges at high velocity on the air pockets in the rotor *A*, imparting to it the first rotary impulse. At this point the air divides, part flowing through the 1/16-in. holes in the rotor and thence toward the center, where it exhausts through the six ⅞-in. holes, while the larger portion of the air flows through the 1/64-in. opening between *A* and *D*, where it comes in contact with the vanes or wings which form part of the rotor and are set at an angle of 45 deg. with the axis of the rotor.

As the combined area of the fifty-seven air ports is approximately 0.098 sq. in., a ⅜-in. air hose would furnish an ample supply of air; but the usual standard connection for small hose is ½ in., and for this reason the air intake of the machine is made of this size.

It is stated that when this turbine runs at full speed it seems to use very little air. (*American Machinist*, vol. 48, no. 16, April 18, 1918, p. 658, 1 fig., *d*)

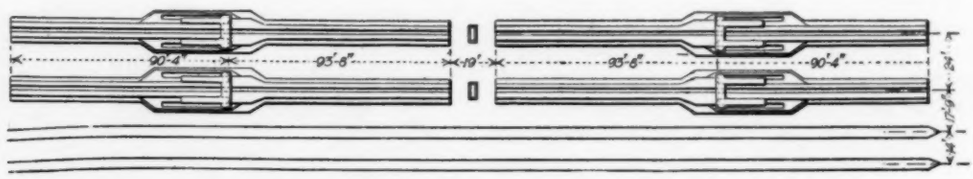


FIG. 6 SHOP LAYOUT FOR FOUR 90-FT. PLANING MACHINES

ADAPTATION OF CARBURETERS TO LOW VOLATILE FUELS, J. H. V. Finney. *The Gas Engine*, vol. 20, no. 5, May 1918, pp. 220-227, 2 figs. Brief discussion of the subject indicated in the title, with the larger part of the article devoted to the description of a special device.

Machine Parts

STANDARDIZATION OF GEARING, B. F. Waterman. *Automotive Industries*, vol. 38, no. 17, April 25, 1918, pp. 827-829.

THICKNESS OF INVOLUTE GEAR TEETH ON ADDENDUM CIRCLE, Reginald Trautschold. *Machinery*, vol. 24, no. 9, May 1918, pp. 800-802, 1 fig.

SALVAGING TOOLS IN WAR TIME, Edward K. Hammond. *Machinery*, vol. 24, no. 9, May 1918, pp. 771-779, 20 figs. A

practical discussion of methods of economizing on tools under the present conditions, when the high prices make it especially essential to salvage tools.

CRANE FOR GUN JACKET SHRINKING SHOP. *The Iron Age*, vol. 101, no. 18, May 2, 1918, pp. 1133, 1 fig.

IMPROVEMENTS IN WATER WHEEL EFFICIENCY, E. C. Hutchinson. *Journal of Electricity*, vol. 40, no. 8, April 15, 1918, pp. 404-406, 2 figs. A discussion of recent developments in the design of water wheels, with examples taken from actual installations.

directions by a man stationed on top of the housings. Four 24-in. handwheels are conveniently located for the operation at this place and the shaft carrying each handwheel also carries an index finger, which, in conjunction with the graduated dial, forms the means of gaging the rate of feed.

Work on the machines was begun December 24, 1917, and in spite of the unusually difficult conditions and unavoidable delays the first machine was ready to run the last week of February 1918, which establishes a record speed for the completion of a machine tool of this size. (*American Machinist*, vol. 48, no. 15, April 11, 1918, pp. 603-608, 15 figs., *d*)

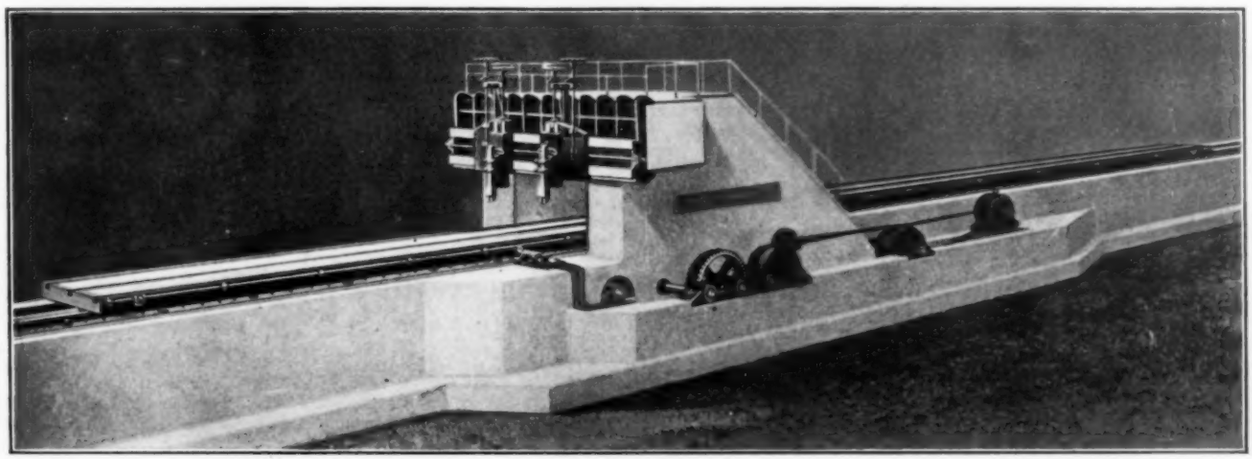


FIG. 7 REINFORCED-CONCRETE PLANING MACHINE WITH 80-FT. BED FOR WORK ON GUN-BORING MACHINES

CONCRETE METAL-PLANING MACHINES, Ethan Viall, Mem. Am.Soc.M.E. Description of a machine tool which represents a radical departure from common practice and may offer important possibilities for the future.

The machines here described were built by the Amalgamated Machinery Corporation, Chicago, primarily for the purpose of planing the beds of large gun-boring machines for the Government. The striking features of their construction and execution are first the use of reinforced concrete for the bed of the machine and next the speed with which the machine was built.

The original construction plan for these machines comprises a battery of four planers, each with a bed 184 ft. long, 17 ft. at its widest place and 18 ft. from the bottom of the bed to the top of the housing. There are approximately 212,000 lb. of iron and steel castings in each machine and about 13,500 cu. ft. of concrete reinforced with 34,000 lb. of steel bars. See Fig. 6.

A view of one of these machines is given in Fig. 7 and details in Figs. 8, 9 and 10.

The bed was designed like a huge concrete girder intended to support a load, which accounts for the high percentage of steel reinforcement. This was done to avoid any possibility of the bed settling at any point and destroying the alignment of the ways.

The bed ways are made with one flat guide and one V-guide. The ways are made in sections 12 ft. long, 4 ft. 10 in. wide and 13 in. through the thickest point. The V is cut with a 50-deg. slope angle and is 10 in. wide at the top of the flare. The flat guide is 10 in. wide at the top. After the table sections have been fastened together concrete is poured into the box-like sections, making the table one long, solid monolith of concrete and iron.

The method of feeding the cutting tools is quite unusual, no automatic means of feeding being supplied. Each cutter head is controlled independently in both horizontal and vertical

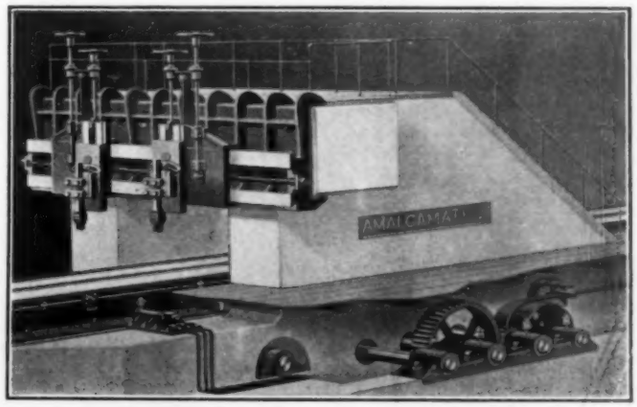


FIG. 8 CONTROL PLATFORM FOR PLANING MACHINE

Measurements

INNOVATIONS WITH RESPECT TO MICROMANOMETERS, M. Berlowitz. (*Zeits. Vereines Deutsch. Ing.* 61, pp. 969-973, Dec 8, 1917.) Interest in air measurements has been aroused during recent years to an unusual degree, particularly as regards ventilators and compressors; in consequence, a large number of manometric improvements have been forthcoming. The author here presents a summary of the various innovations which have been proposed. The differential manometer of G. Recknagel, which itself was a development of Péclet's earlier apparatus, and which for a number of years was the only instrument for measuring very low pressures, is first described in detail. Owing to serious inconvenience involved in the use of this instrument, a new construction was proposed by Krell, to which he gave the name micromanometer. A full de-

scription of this apparatus is given in the paper. Further improvements by Berlowitz and Schultz are then discussed, the various details being illustrated by eight diagrams. The paper concludes with a mathematical discussion of the mechanism of manometric measurement, accompanied by two tables of results. (*Science Abstracts,* Section A—Physics, vol. 21, part 3, no. 243, March 31, 1918, pp. 90-91.)

PLATE FULCRUM VERSUS KNIFE EDGE TRACK SCALES, A. Bousfield. *Scale Journal,* vol. 4, no. 7, April 1918, pp. 12-16, 24 figs.

PERFORMANCE TESTS BY ACCELEROMETER, H. C. Skinner. *Automotive Industries,* vol. 38, no. 17, April 25, 1918, pp. 816-817, 5 figs. Description of the use of an instrument for determing acceleration and deceleration of motor cars in road tests.

PROPERTIES OF MANGANESE BRONZE TEST COUPONS. *The Foundry,* vol. 46, no. 309, May 1918, pp. 218-219, 6 figs., 3 tables. A practical article giving test data of various manganese-bronze test coupons, of interest because of the fact that the method of testing of manganese-bronze castings is still a somewhat mooted subject.

MINNESOTA TRACK SCALE SPECIFICATIONS AND TOLERANCES. *Railway Age,* vol. 64, no. 18, May 3, 1918, pp. 1113-1115, 4 figs.

ENGINE TEST LABORATORY. *Automotive Industries,* vol. 38, no. 18, May 2, 1918, pp. 868-869. Description of a mechanical testing laboratory recently completed by the Minneapolis (Minn.) Steel and Machinery Co., mainly for testing engines in their tractors.

RECORDING THERMOMETER, C. V. Boys. *Proceedings of the Physical Society of London,* vol. 30, pt. 2, February 15, 1918, pp. 94-99, 5 figs. Description of a laboratory recording thermometer of comparatively simple construction.

APPARATUS AND MACHINES FOR TESTING OF AEROPLANE MATERIALS. *Canadian Machinery,* vol. 19, no. 18, pp. 465-468, 8 figs.

ERICHSEN TESTS ON ALUMINUM SHEETS, Robt. J. Anderson. Results of tests made with the Erichsen ductility testing apparatus on annealed 18-gage aluminum sheets. The Erichsen apparatus consists essentially of a die and holder for holding the sample to be tested and an internal tool actuated by a hand wheel which moves gradually forward until the sample is ruptured. The progress of the internal tool and the ultimate fracture are observed in a mirror and the depth of indentation is read directly from a micrometer graduated screw.

One of the features of this test is the evidence of approximate grain size of the metal tested, which fractured domes of the test pieces indicate. This makes this test valuable as a guide to drawing operations on an annealed metal, since underannealed metal will rupture by deep draws owing to its hardness and lack of ductility, while overannealed metal will also rupture because of the weakened condition of the metal resulting from large grain size.

The Erichsen test indicates how a given metal may be expected to behave in the draw press; in fact, the apparatus itself is nothing but a miniature draw press. The ductility control of metal going into draw-press work may be expected to reduce the percentage of scrap largely and to provide a rational basis of control for the annealing operations.

In this instance are described tests on 18-gage aluminum sheets, preliminary tests being made on a lot which had worked badly in the draw press. Then a number of tests were made upon 18-gage cold-rolled aluminum sheets reduced in the cold from a 0.25-in. slab to 18 gage. The metal employed

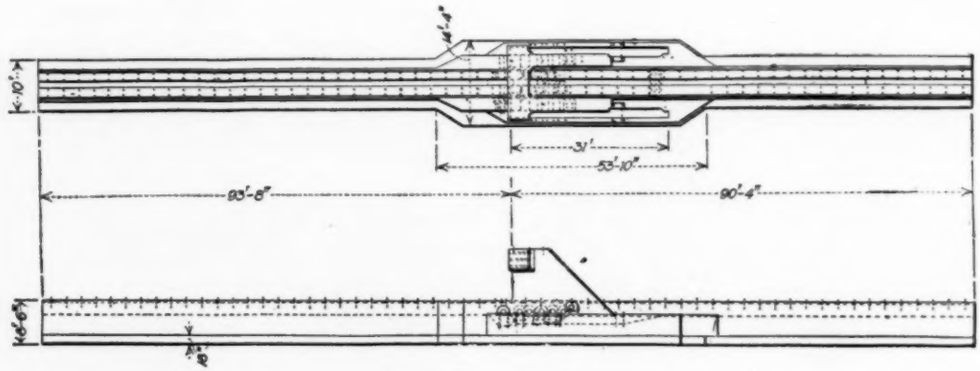


FIG. 9 PLAN AND SIDE ELEVATION OF PLANING MACHINE

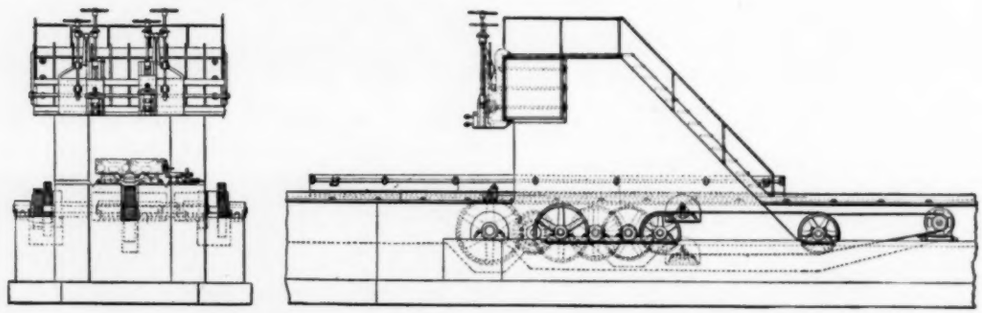


FIG. 10 DETAILS OF REINFORCED-CONCRETE PLANING MACHINE

TABLE 1 EFFECT OF ANNEALING 18-GAGE ALUMINUM SHEETS: TEMPERATURE VARIABLE, AND TIME CONSTANT AT TWO HOURS

Sample	Temperature in deg. cent.	Thickness in millimeters	Indentation in millimeters	Scleroscope hardness	Appearance of domes
1	As rolled	1.08	6.83	14.0	....
2	100	1.08	6.96	13.5	....
3	200	1.09	8.39	10.0	....
4	300	1.07	10.17	4.5	Smooth
5	400	1.07	10.10	4.5	Medium
6	500	1.09	9.73	4.0	Coarse

Note—(*a*) Time constant at 120 min.; (*b*) Values given represent the mean of two closely agreeing determinations.

TABLE 2 EFFECT OF ANNEALING 18-GAGE ALUMINUM SHEETS; TIME VARIABLE AND TEMPERATURE CONSTANT AT 200 DEG. CENT.

Sample	Annealed, minutes	Thickness in millimeters	Indentation in millimeters	Scleroscope hardness	Appearance of domes
7	5	1.07	6.89	13.8	....
8	30	1.07	7.97	11.8	....
9	60	1.08	8.40	9.5	....
10	90	1.09	8.84	8.0	....
11	150	1.09	8.87	8.0	....

Note—(*a*) Temperature constant at 200 deg. cent.; (*b*) Values given represent the mean of two closely agreeing determinations.

was American metal of high purity containing over 99 per cent aluminum with impurities normal. The annealings were made in a laboratory electric furnace of the resistance type under pyrometric control and the temperatures are accurate within 10 deg. cent. The results are given in tables, of which two are here reproduced. Table 1 shows that the metal under discussion attained maximum softness by annealing at 300 deg. cent. for two hours. The effects of annealing at the constant temperature of 200 deg. cent. for various times is given in Table 2 and the data therein show that 200 deg. cent. is too low a temperature to employ for annealing 18-gage cold-worked sheets. Other tables show that complete softening below 5 Shore scleroscope number was obtained by annealing for 1 hr. and 20 min. at 300 deg. cent. Another table shows that complete annealing may be effected by an exposure of 5 min. at 400 deg. cent., which indicates that long-time exposures are unnecessary and may often lead to an increase in waste of material. Figs. 11 and 12 graphically reproduce the data in Tables 1 and 2, while Fig. 13 shows what happens in the case of annealing at 400 deg. cent.

The original article also refers to two other figures, which, however, do not appear in the article. (*The Iron Age*, vol. 101, no. 15, April 11, 1918, pp. 950-951, 4 figs. *ep*)

Mechanics

THE VALUE OF "*g*" IN ENGINEERING AND PHYSICAL WORK. Sanford A. Moss. The effects of variations in gravity, the cases where the effects are negligible, and the cases where they must be taken into account, are discussed from the point of view of the engineer and physicist.

The correction data, previously given completely only in inaccessible treatises on geodesy, are given in a form more convenient for actual use than ever given before.

The author collaborated with the Coast and Geodetic Survey officials, and with Prof. E. V. Huntington, so that the data may be regarded as authoritative.

The standard value, g_n, is 980.665 cm./sec.^{2} or 32.1740 ft./sec.^{2} This has been arbitrarily selected by international agreement. It is nearly the average value at sea level, 45 deg. N. latitude, but is to be arbitrarily maintained regardless as to whether it is the exact average value, and regardless of

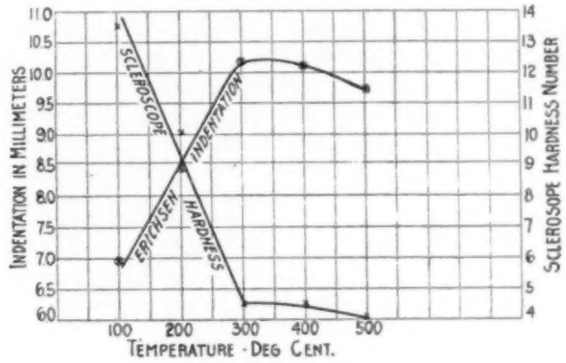


FIG. 11 TEMPERATURE-INDENTATION AND TEMPERATURE-SCLEROSCOPE-HARDNESS CURVES FOR ANNEALINGS ON 18-GAGE ALUMINUM SHEETS. TIME CONSTANT AT 120 MIN.

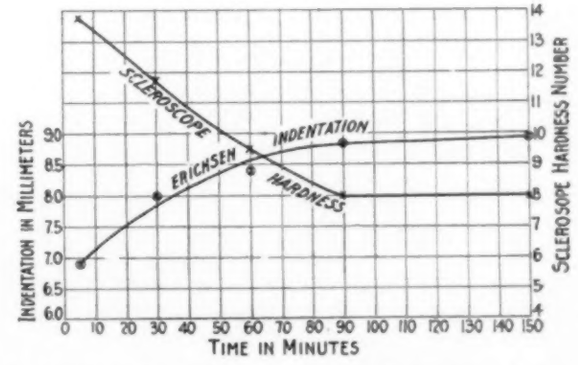


FIG. 12 TIME-INDENTATION AND TIME-SCLEROSCOPE-HARDNESS CURVES FOR ANNEALINGS ON 18-GAGE ALUMINUM SHEETS. TEMPERATURE CONSTANT AT 200 DEG. CENT.

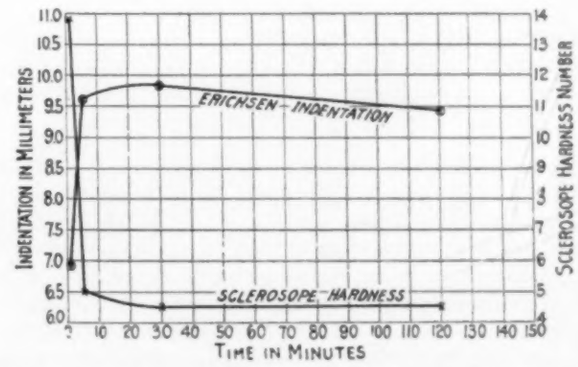


FIG. 13 TIME-INDENTATION AND TIME-SCLEROSCOPE-HARDNESS CURVES FOR ANNEALINGS ON 18-GAGE ALUMINUM SHEETS. TEMPERATURE CONSTANT AT 400 DEG. CENT.

changes in the average observed value due to addition of new data.

In all cases where a force of a pound is used it is to be understood as being the "standard pound force," which is a force giving the "standard weight" of one pound an acceleration of the standard value, g_n.

Whenever forces are measured by instruments which depend

upon the attraction of gravity, the readings must be reduced to standard pounds by use of the correction factors given. Examples are: platform scales used with Prony brakes or similar brakes, dead-weight gages, mercury or water U-tubes, and testing machines. The correction for latitude has a maximum value of about fourteen hundredths of one per cent (in the southernmost part of the United States.) The correction for elevation is about one one-hundredth of one per cent per 1000 ft. elevation. There is a further correction for "anomaly," which is about one one-hundredth of one per cent on a few mountains and less than half of this value everywhere else, so that it is negligible for engineering work.

The following table gives the principal correction factor to within 1/100 of one per cent, which is accurate enough for engineering purposes.

We multiply the measurements of a force in a weight scales by the correction factor in the body of the table and add it to the reading.

North latitude, deg.	Elevation in feet, H_f							
	0	2000	4000	6000	8000	10000	12000	14000
25	−.0017	−.0019	−.0021	−.0023	−.0025	−.0027	−.0029	−.0031
30	−.0014	−.0016	−.0018	−.0019	−.0021	−.0023	−.0025	−.0027
35	−.0010	−.0011	−.0013	−.0015	−.0017	−.0019	−.0021	−.0023
40	−.0005	−.0007	−.0009	−.0011	−.0013	−.0015	−.0017	−.0019
45	−.0001	−.0002	−.0004	−.0006	−.0008	−.0010	−.0012	−.0014
50	+.0004	+.0002	.0000	−.0002	−.0004	−.0006	−.0007	−.0009

More accurate correction data are given, which are needed, however, only for refined physical work.

Taking W_0 as the weight of a body at any point found by comparing it with the "standard pound weight" by means of a weight scales, F as force measured in "standard pounds" as already defined, and a as acceleration in ft./sec.^{2}, the well-known fundamental equation then becomes

$$F = W_0 a / g_0$$

In all formulæ in which g occurs in connection with the standard units mentioned, the value is understood as being g_0, regardless of place.

The now usually accepted definition makes the horsepower exactly equal to 746 watts. This gives 550.22 "standard foot-pounds." (*General Electric Review*, vol. 21, no. 5, May 1918, *gt*)

DESIGN OF SPRINGS FOR OSCILLATING MASSES, G. Lindner. (*Zeits. Vereines Deutsch. Ing.* 61, pp. 907-912, Nov. 10, 1917.) The author cities various applications in which oscillating masses are fitted with springs to relieve a crank drive of acceleration forces or, in general, to permit a certain latitude of motion in one part while relieving others of shock. A number of formulæ are given to facilitate the choice of a suitable type and size of spring for any particular application. One of the primary functions of springs is to relieve the driving members (e.g., connecting rod, eccentric and crankshaft bearings, etc.) of "free forces" due to reversal of oscillating masses, which free forces cannot be balanced within the machine itself. The spring should be capable of continuing the oscillating motion; in other words, the drive has only to overcome the air resistance and friction of the moving parts once the oscillation is started. In order to secure the same frequency, the force exerted by the spring at maximum deflection must equal the centrifugal force of the oscillating mass at its dead point. The centrifugal force exerted at the distance r cm. from the center by G kg. at n revolutions per minute is: $P = G(r/100)(n/30)^2$. The spring is designed so that it is deflected r cm. by the force P, and is not then overstressed. The present comparison between various types of springs is based on the following assumptions: Spring steel with $E = 2{,}200{,}000$ kg./cm.^{2}; bending stress at deflection r cm. = 3000 kg./cm.^{2} unhardened and 4000 to 5000 kg./cm.^{2} hardened; half these values for machine steel. In a numerical example for each case $G = 50$ kg.; $r = 2$ cm.; $n = 300$ r.p.m.; then the centrifugal force and spring force $P = 100$ kg. The cases considered are: Parallel plate spring with one end fixed and with both ends fixed; triangular plate springs and the practical form of the latter, the trapezium plate; rectangular and round rod springs (including the case of a bundle of rods and that of rods held at both ends); cubic paraboloid (round rod to uniform resistance); and tapered round-rod springs. In each case formulæ are given for the relation between length and cross-section of springs, for the volume and for the work done in bending the springs, etc. The liability to buckling is discussed, and it is shown how to complete practical designs after obtaining the dimensions theoretically desirable. Sections of uniform resistance or approximations thereto are most economical of material. Rod springs of standard profile may be conveniently applied to a variety of load conditions and they are flexible in all directions. Parallel round-rod springs require four times as much material as triangular plate springs and 4/3 times as much material as parallel plate springs and rectangular rods owing to the fact that maximum stress exists only in the clamped section and along the outer fiber thereof. If the form of the rod be a cubic paraboloid, the material required is only 1/3 that of a cylindrical round rod and 4/3 that of a triangular plate spring. The section in which maximum stress occurs in a tapered round rod depends on the degree of taper. Up to the critical ratio of taper, $D/d = 1.5$, the stress at the clamp determines the design; with more pronounced taper, the danger section moves toward the point of the spring. The relative economy in material of various patterns of spring is shown by the following formulæ for their volume:

	Volume			Volume
Parallel plate spring	2.2 *Pr*		Plain taper round rod:	
Triangular plate spring	0.73 *Pr*		With $D/d = 1.0$	2.935 *Pr*
Trapezium plate spring:			$D/d = 1.25$	1.91 *Pr*
limits	0.73 to 2.2 *Pr*		$D/d = 1.5$	1.377 *Pr*
Trapezium plate spring:			$D/d = 1.84$ (max.	
$b/B = 1/5$	0.97 *Pr*		economy)	1.18 *Pr*
Rectangular-rod spring	2.2 *Pr*		$D/d = 2.0$	1.20 *Pr*
Parallel round-rod spring	2.935 *Pr*		$D/d = 2.5$	1.45 *Pr*
Cubic paraboloid	0.978 *Pr*		$D/d = 3.0$	1.88 *Pr*

The thickness of a plate spring is limited by the deflection, and its breadth by the force and frequency. In a bundle of spring rods either the number or the length may be chosen freely. Some of the formulæ in the original may be simplified for approximate calculations. (*Science Abstracts*, Section B—Electrical Engineering, vol. 21, part 2, no. 242, pp. 64-65)

LES DÉPLACEMENTS DANS LES CHAMPS DES VECTEURS ET LA THÉORIE DE LA RELATIVITÉ, H. Varcollier. *Revue Générale des Sciences Pures et Appliquées*, 29e Année, no. 4, February 28, 1918, pp. 101-114. Discussion of displacements in vectorial fields and their bearing on the theory of relativity.

QUICK DESIGN OF T-BEAMS, Wm. Osborne Sell. *Concrete*, vol. 12, no. 4, April 1918, pp. 135-136, 5 figs.

INGENIOUS MECHANICAL MOVEMENTS, Franklin D. Jones. *Machinery*, vol. 24, no. 9, May 1918, pp. 781-787, 15 figs.

AN INTERESTING APPLICATION OF A REDUCTION GEAR. *The Electric Journal*, vol. 15, no. 5, May 1918, pp. 152-155, 9 figs.

OM GLIDNINGSFRIKTION I KULLAGER. *Teknisk-Tidskrift*, Mekanik, 48 Arg., Haft 3, March 13, 1918, pp. 28-34, 14 figs. Discussion of sliding friction in ball bearings.

COMPRESSIBILITÉ ET DILATABILITÉ DES GAZ, M. A. Beduc. *Annales de Physique*, tome 9, January-February 1918, pp. 5-28, 6 figs. Investigation of the subjects of compressibility and expansibility of gases.

Military Engineering and Munitions

MANUFACTURING THE 75 MM. HIGH EXPLOSIVE SHELL, J. H. Rodgers. *Canadian Machinery and Manufacturing News*, vol. 19, no. 16, April 18, 1918, pp. 399-403, 8 figs., 1 chart. (to be continued).

MANUFACTURE OF THE 4.7-INCH GUN, MODEL 1906-11, E. A. Suverkrop. *American Machinist*, vol. 48, no. 16, April 18, 1918, pp. 649-658, 26 figs.

IL PROBLEMA DEL TIRO ANTIAEREO, Giuseppe Fioravanzo. *Rivista Marittima*, Anno 50, no. 12, December 1917, pp. 323-351, 6 figs. An extensive mathematical discussion of the problem of anti-aircraft firing. The ballistics of anti-aircraft shells are investigated.

EXPERIMENTS WITH ELEY LEAD CRUSHERS, F. W. Jones. *Arms and Explosives*, vol. 26, no. 307, April 1, 1918, pp. 48-49, 1 fig., 2 tables. Continuation of the article on the same subject abstracted in the previous issue. An abstract of this part will appear in an early issue of THE JOURNAL.

INSPECTION OF THE U. S. 75-MILLIMETER SHELL, Erik Oberg. *Machinery*, vol. 24, no. 9, May 1918, pp. 794-799, 9 figs.

MACHINING A NOSED-IN SHELL, M. H. Potter. *Machinery*, vol. 24, no. 9, May 1918, p. 780, 1 fig.

BRASS FOR FUSES AND OTHER MUNITION PRODUCTS, Alex. E. Tucker. *The Metal Industry*, vol. 16, no. 5, May 1918, pp. 212-214.

Motor Cars

SUBSTITUTIONAL TIRING FOR PASSENGER AUTOMOBILES, A. Heller. (*Zeits. Vereines Deutsch. Ing.* 61, pp. 879-881, Oct. 27, 1917.) During the last year various substitutes have been devised for pneumatic tires on passenger automobiles; these substitutes being practicable under war conditions, though not entirely satisfactory. The decree of December 18, 1916, relaxed the law restricting the speed of vehicles with other than rubber or similar elastic tires to 25 km. per hr. The decree of April 24, 1917, recognized six patterns of substitutional tiring as permissible until further notice.

Substitutes for pneumatic tires fall into two classes: (1) Those with a rigid rim of metal or wood capable of moving only in the direction of the spokes; and (2) those in which "spoke springing" is supplemented by a species of "rim springing," i.e., a flexible rim in addition to springs between the two rims. Typical examples of both types of tires are given in the original.

The Arop wheel is simple and effective. A single or a double row of spiral springs wound from square steel is carried by doweled spring plates or mountings between an inner and outer rim; but this arrangement is not suitable for high-speed vehicles because the springs are not secure against displacement by lateral forces when running round curves or over obstacles. This risk is eliminated in the Moll wheel by placing each spring between two end caps which are spherical on their outside and provided with tubular extensions down the inside of the spring. One of these extensions slides within the other, forming a telescopic combination which prevents lateral displacement of the spring, while the spherical ends permit lateral displacement of the rim.

The special advantage of the Fruth wheel, built by the Maschinenfabrik Augsburg-Nürnberg, is that the springs are protected against bending or displacement by the peripheral force accelerating or retarding the vehicle. Oval springs are placed between the inner and outer rim on their sides, so that the wheel pressure comes in the plane of the winding. Successive springs are overlapped (going circumferentially round the wheel), and cross-bolts pass through the overlapping loops. The springs lie in two U-troughs which fit one within the other and relieve the springs from all transverse forces. The outer rim and the complete spring system can be mounted as one piece on the inner rim as substitute for a rubber tire. Replacement of broken springs is not easy.

The Sievert wheel uses a composite wooden rim (part of its timber being cross-cut) with steel side rings, between which and the sides of the inner rim are rings of rubber or other elastic material. The whole load is transmitted through the rubber side rings; these have a long life, since they are protected by the side plates. Wear comes on the wooden road rim.

The Siemens and Halske wheel uses spiral springs mounted radially between cups attached to the inner and outer rims. In addition, the outer rim consists of continuously wound strip steel secured by cross-clamps at intervals and protected by leather or similar material which is riveted on and renewed as required. The springs are inadequately protected against dirt and against transverse forces, but the elastic rim improves the smooth running of the wheel and reduces the risk of side slip. The Flohr wheel is of similar construction, but the outer rim is built up on the same principle as the link belt. The link pins serve as supports for the spring cups on the outer rim, but they are not protected against dirt and water. (*Science Abstracts*, Section B—Electrical Engineering, vol. 21, part 3, no. 243, March 31, 1918.)

Railroad Engineering

INTENSIVE LOCOMOTIVE DEVELOPMENT, Capt. O. S. Beyer, Jr. *Railway Mechanical Engineer*, vol. 92, no. 4, April 1918, pp. 187-188 (Part 2).

CORROSIONS PROVOQUÉES PAR L'ACIDE CARBONIQUE DE LA VAPEUR DANS LES MACHINES MOTRICES À VAPEUR, Dr. Ch. Chorower. *Revue Générale de l'Électricité*, 2 Annee, tome ? no. 14, April 6, 1918, pp. 509-511, 3 tables. Discussion on the subject of corrosion in steam engines produced by the presence of carbon dioxide in steam.

SANTA FE LOCOMOTIVE FOR THE BELT RAILWAY OF CHICAGO. *Railway Review*, vol. 62, no. 17, April 27, 1918, pp. 611-612, 1 fig.

COMBINED STEAM AND WESTINGHOUSE BRAKE VALVE. *The Engineer*, vol. 125, no. 3250, April 12, 1918, p. 324, 1 fig. Description of a new device recently placed on the market in England.

SAVING COAL BY MIXING. Description of experiments on the Lehigh Valley R. R., where it is said the consumption of coal has been reduced by nearly a third by using the new plan.

This new plan provides for the crushing of bituminous coal and its mixture with anthracite silt, using two parts of the soft coal to one of the silt. Silt or slush is a dust which has passed through a mesh with openings less than 3/32 in. in diameter. It has always been considered as a useless waste, and all over the anthracite fields there are lying great banks of such silt.

A mixing plant has been erected at Hazleton, Pa., where the soft coal is crushed and mixed mechanically with the silt in the proper proportion. Additional mixing plants are now in process of erection. The process is important in view of the fact that it is estimated that millions of tons of silt are available. (*Railway and Locomotive Engineering*, vol. 31, no. 4, April 1918, p. 117.)

BRAKE CONDITIONS IN GENERAL FREIGHT SERVICE AND THEIR RELATION TO SHOCKS AND BREAK-IN-TWOS, H. F. Wood. *New England Railroad Club*, April 9, 1918, pp. 71-107.

THE WASTE-HEAT BOILER FOR MALLEABLE FURNACES, Arthur D. Pratt. Paper presented at the Boston convention of the American Foundrymen's Association. The theory of the waste-heat boiler is discussed and its advantages in the application in malleable-cast-iron foundries brought out.

The writer points out the changes in waste-heat-boiler design which have been developed in the last five years by a better comprehension of the theory of operation of this unit. The fact is especially brought out that in the modern design of waste-heat boilers high gas velocities are employed to secure the necessary rates of heat transfer. This necessitated the use of much smaller gas-passage areas, which, in turn, resulted in a greatly increased draft resistance through the boiler, with such changes in design as would naturally be brought about by this. (*The Foundry*, vol. 46, no. 309, May 1918, pp. 221-226, 6 figs.)

VALUE OF HIGHER STEAM PRESSURES, J. T. Foster. *Electrical World*, vol. 71, no. 19, May 11, 1918, pp. 977-978, 2 figs.

Steam Engineering

FEED ARRANGEMENTS FOR TURBINES HAVING A STEAM VELOCITY GREATER THAN THAT OF SOUND, G. Zerkowitz. (*Zeits. Vereines Deutsch. Ing.* 61, pp. 869-873, Oct. 27, and pp. 889-892, Nov. 3, 1917.) The present papers contain a critical examination of the conditions prevailing in the inlets of steam turbines working at velocities exceeding that of sound. The form of the radial deflection of the inlet current of steam was determined for the cases of an ordinary parallel-walled pipe and a DeLaval nozzle. The experimental procedure adopted is described in detail. It was found that, at the diagonal cut, there was at one time the behavior of an enlargement, and at another time of a constriction. The case of free expansion was studied and a relation obtained for the average deflection which shows a noteworthy agreement with radial diagrams already in existence. It appears that the average deflection hereby arising is smaller than that given for a simple expansion from a point—a circumstance which is of value for the case of slot expansion. Finally the procedure during expansion from a point was examined and graphed. From the results the deviations which occur with ordinary feed apparatus were established, and a method of adjustment thereby indicated for obtaining a uniform deflection of all stream lines when the steam velocities are greater than that of sound. (*Science Abstracts*, Section B—Electrical Engineering, vol. 21, part 3, no. 243, March 31, 1918, pp. 81-82.)

TEMPERATURE CONTROL FOR SUPERHEATED STEAM, H. Huebner. (*Zeits. Vereines Deutsch. Ing.* 61, pp. 885-888, Nov. 3, and pp. 921-924, Nov. 17, 1917.) It is impossible to obtain precisely the desired superheat unless some means of control is provided. The dryness factor of steam leaving the boiler depends on the water circulation, which latter, even in the same boiler, varies with load and other factors. The heat-transmission factor is commonly taken to vary only with the velocity of the gases, but the temperature difference between gases and steam has undoubtedly an important effect. Even were a completely reliable formula available, it would still be impossible to determine the actual value of all the variables and to realize exactly the anticipated superheat. The steam temperature varies with the length of flame; and a higher temperature is reached with mechanical stoking and ash removal than when doors are opened frequently under manual control. Temperature and quantity of flue gases and dryness of steam vary considerably with the load on the boiler.

The effect of the superheat may be controlled by dampers, by water cooling, or by varying the moisture content of the "saturated" steam. Control by dampers is used most frequently, but this is not the best system. It is true that damper control strikes right at the root of the matter by cutting off the flue gases more or less completely from the superheater, but the damper doors are heavy to move and require massive supports, also they depreciate rapidly in service. The author illustrates several arrangements of swinging dampers and discusses their merits and defects. In one good form the dampers are not exposed to the hottest gases. It is generally easier to accommodate the dampers in water-tube boilers with vertical or steeply inclined tubes. Sliding dampers of refractory material are more durable and reliable than pivoted metal dampers in boilers with very high superheat. Bypass openings with refractory shutters may be used to allow more or less of the flue gases to escape without passing through the superheater; the bypass is adjusted to give correct superheat on normal load. On the other hand, the use of a bypass involves some sacrifice of boiler efficiency even though the hotter emerging flue gases be passed through an economizer. Any arrangement of dampers which involves providing a second gas path below the superheater, necessitates higher and more costly boiler setting and boiler house.

The Babcock and Wilcox temperature control uses the boiler water to cool the superheated steam to the desired temperature. This system is conveniently efficient and gives accurate control over a wide range without wasting space. A 3-way valve is used to determine the proportion of the superheated steam that is passed through the cooling pipes in the boiler. The steam temperature in the superheater itself is unaffected by this system of control and should therefore not exceed 480 deg. to 500 deg. cent., or there will be serious risk of the superheater tubes being overheated and softened. Subdivision of the superheater and taking part of the steam out to a cooling pipe in the boiler before returning it to the superheater, does protect the latter, but also introduces additional pipes, fittings, and pressure loss.

In the Kose regulator all the superheated steam is passed through a bundle of cooling tubes which is automatically submerged to a greater or less extent in the boiler water so as to maintain any desired steam temperature. If steam be passed through an independent cooling drum (fed with hot feedwater and delivering any steam raised to the main boiler), the

temperature of superheat is controlled effectively and the cooler and boiler are both more accessible for cleaning, etc. In the Wedertz regulator, water from the boiler is passed through a cooling tube mounted concentrically in a late stage of the superheater. Steam raised in the cooling tube is admitted to the steam main. The superheater itself is protected by this device, but fitting the cooling tubes offers mechanical difficulties. The Steinmuller regulator bypasses part of the steam rising through the front header and uses it to blow more or less water into the steam going to the superheater. From 80 to 100 deg. cent. control is obtained and the superheater does not exceed the temperature of the steam delivered. In the Germaniawerft regulator, water is sprayed into the superheater tubes from a concentric water pipe which has a number of fine holes on a spiral at the base of a helical strip mounted between the two tubes and serving to insure thorough evaporation.

In order to prevent formation of scale deposits in the superheater, Walther et Cie. use for cooling the overheated steam only pure condensate obtained by taking part of the boiler steam over a miniature surface condenser through which feedwater passes. In any case it is important that no unvaporized water particles be carried forward by the superheated steam. Temperature reduction by mixing saturated with superheated steam is practicable only where the superheat is moderate and the desired temperature decrease is small. A 3-way hand valve or an automatic valve may be employed. (*Science Abstracts*, Section B—Electrical Engineering, vol. 21, part 3, no. 243, March 31, 1918, pp. 86-87.)

STEAM TURBINE OF LARGE SPECIFIC OUTPUT AND THE EMPLOYMENT OF DISKS WITH SHRUNK-ON BOSSES. In order to take care of the great volume of steam after it has expanded and at the same time to avoid excessive leakage losses, the last disk of a large turbine must be of great diameter and have long blades. The body of the disk is then subject to great peripheral strains and speeds, and from this point of view has already pretty nearly reached the limits permitted even with the use of the best steel available. The writer shows, however, that these limits of loads and speeds may be materially reduced by a new method of construction of the turbine disks, based on the use of shrinking on in hub construction.

The writer starts by investigating the conditions under which the last disk of the turbine delivers the desired amount of power when rapidly rotating. While the absolute velocity V of the steam as it leaves every other disk may be high without inconvenience, because the energy which it represents is to a large extent recovered in the next disk, this does not apply to the case of the last disk, because there this velocity constitutes a loss (exhaust loss) the value of which it is well to know.

Assume a turbine which delivers 15,000 hp. at 3000 r.p.m. with an hourly consumption of 52,500 kg. of steam per hour. When expanding into a vacuum of 96 per cent, which is now common practice, this amount of steam represents a volume of 1,620,000 cu. m. and hence the last disk of the turbine has to handle 450 cu. m. (15,885 cu. ft.) per sec.

Let D_m = the average diameter of the disk in meters
S = surface covered by the blades of the disk
v = average tangential velocity of the blades
V' = relative velocity of steam at exhaust, Fig. 14
V = absolute remaining velocity of steam at exhaust
V_a = axial component of V' and V.

The condition is that $S \times V_a = 450$.

The length of the blades cannot usefully exceed one-sixth of the average diameter of the disk. If this maximum value be here adopted the preceding condition may be written as

$$D_m^2 \times V_a = 860$$

The ratio V_a/V' depends on the shape of the blades. The writer considers in this connection the three values of 0.5, 0.6, 0.7, of which the last seems to be the limit of what can be done. Once this ratio has been selected, all that is necessary is to select the value of D_m, in order to determine the velocities v, V_a, V', V and the exhaust loss $U_r = V^2/g$. If we take a kilogram (2.2 lb.) of steam assumed to be initially at 12 kg. pressure and 325 deg. cent. temperature and to contain an amount of energy equal to 95,000 kg-m., then the quotient $U_r/95{,}000$ represents the losses at the exhaust in percentage of energy initially available. The results of the computations carried out with various values of D_m are given in Table 3, and graphically expressed in Fig. 15. From these data it appears that it would have been good practice to give to the last disk of a turbine a diameter of from 2 m. to 2.2 m. Further, without making the consumption excessive D_m could be made 1.8 m. These values would permit the utilization in the last disk of one-fourth of the total energy available and bring us to a turbine with a comparatively small number of disks, for example, four, if all disks are of the same diameter.

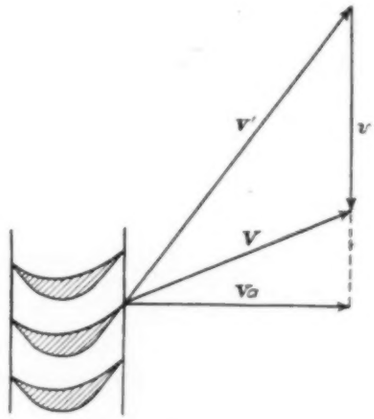


FIG. 14 DIAGRAMS OF VELOCITIES AT EXIT FROM DISK

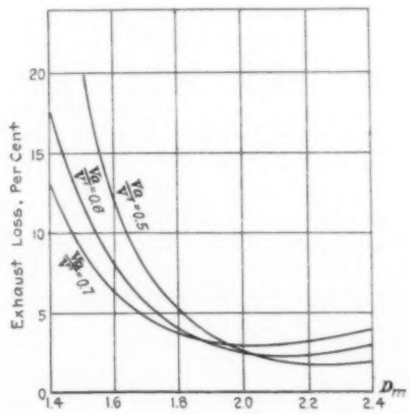


FIG. 15 GRAPHICAL REPRESENTATION OF THE MAGNITUDES OF EXHAUST LOSSES

As regards the hub C of such a disk, one must bear in mind that the diameter $D = 1.4$ m. (Fig. 16) and that the load uniformly distributed over its periphery amounts to about 750 tons due to the action of the centrifugal force on the blades and on the rim which encloses them. It is easy to see that

such loading conditions could not be applied in the case of a disk rotating at 3000 r.p.m. and built up of a single forging —hub and blade in one piece—as is the standard practice today, because such stresses would produce an excessive fatigue in the metal.

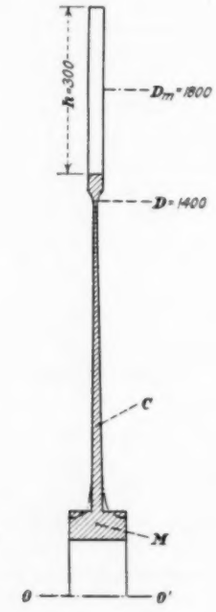


FIG. 16 SECTION OF THE LAST DISK WITH BLADES

The writer presents, therefore, a novel solution for the problem of disk construction based on the employment of shrunk-on collars on the hub.

A disk with a central bore comprises a body C (Fig. 16) and a hub M having parallel faces. This hub in itself is really a first disk of constant thickness having a low tangential velocity and acting as a basis for the radial stresses developed in the body C.

The body C and the hub M are usually connected by fillets which greatly reduce the harmful influence of reëntering angles, but these fillets may be made of quite small diameter on condition that they are located in a region of reduced stresses, it being quite easy to create such a region by a slight, purely local correction in the shape of the disk.

From this the writer proceeds to the discussion of the calculation of disks of uniform thickness. He uses a formula given by Anspach and Stodola, namely,

$$t = a + \frac{b}{r^2} - \frac{13}{32} Ar^2 \quad \ldots\ldots [1]$$

$$t' = a - \frac{b}{r^2} - \frac{7}{32} Ar^2 \quad \ldots\ldots [2]$$

in which t and t' are respectively the radial and tangential stresses present in the metal at a distance r from the axis of the disk. $A = \omega^2 \frac{\delta}{g}$ is the product of the mass of a unit of volume of metal by the square of the angular velocity, while a and b are constants determined by the limiting conditions.

If r be expressed in meters and if $\frac{\delta}{g} = 800 \times 100^{-6}$ (for steel), then the main stresses t and t' may be expressed in kilograms per square millimeter by the preceding equations.

As regards disks of variable thickness, making one piece with the hub, their investigation is based on the use of two fundamental equations with three variables, these variables being, for example, the main stresses t and t' and the thickness z of the disk. Because of this, some additional arbitrary relation must be assumed in order to make possible the solution of these equations. The equations are as follows:

$$Ar + \frac{dt}{dr} + \frac{t}{z}\frac{dz}{dr} = \frac{t' - t}{r}$$

$$4\frac{dt'}{dr} - \frac{dt}{dr} = \frac{5}{r}(t - t')$$

TABLE 3 RESULTS OF CALCULATIONS WITH VARIOUS VALUES OF D_m

D_m	z	V_a	Exhaust loss for		
			$\frac{V_a}{V'} = 0.5$	$\frac{V_a}{V'} = 0.6$	$\frac{V_a}{V'} = 0.7$
			Per cent	Per cent	Per cent
1.4	220	439	37.3	17.5	13.1
1.6	251	336	11.9	8.15	6.5
1.8	282.5	265	5.43	4.03	3.78
2.0	314	215	2.67	2.52	2.96
2.2	345.5	178	1.78	2.34	3.17
2.4	377	149	1.95	2.89	3.92

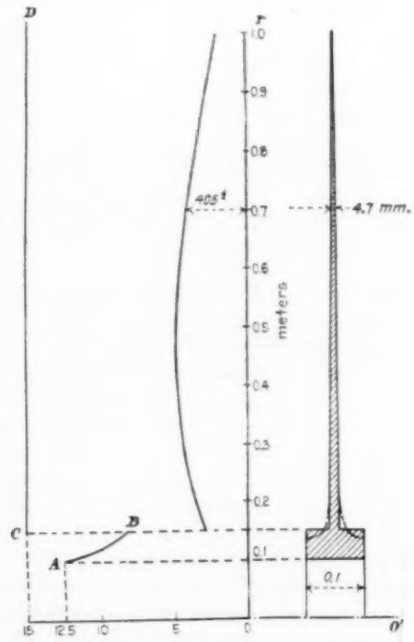


FIG. 17 SECTION OF ORDINARY DISK

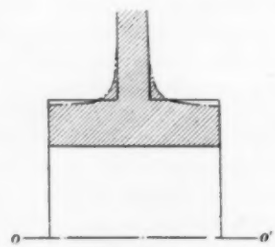


FIG. 18 HUB OF WRONG DESIGN, OF EXCESSIVE LENGTH

The solution of the auxiliary relation is actually limited by the fact that our knowledge is not always sufficient to enable us to carry out these computations. Nevertheless a good many examples which may be utilized in this conection are found in the works of Anspach and Stodola. The trouble is that even if various equations make it possible to arrive at certain results, these results are not always equally good, and one has to ask oneself which of the relations is the best. This question is of basic importance for practical purposes and the writer claims to be able to make an addition to the fund of knowledge given by the two investigators cited above.

A priori the best ratio is such as would at all points give to the two main fatigue values as nearly as possible approaching the limit F, a limit which should never be exceeded. In this way the utmost utilization of the metal is secured. This ratio is as follows:

$$t - t'/4 = F$$

and it shows that the radial fatigue (which expresses the proportional elongation) is constant and equal to the assumed

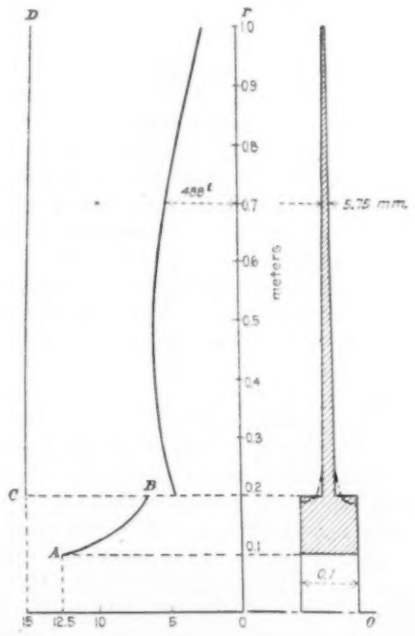


FIG. 19 SECTION OF DISK WITH REINFORCED HUB

limit F. The tangential fatigue, always quite small in the neighborhood of the hub, grows with great rapidity along the radius and tends toward the same value F. The comparison of the results thus obtained with those which follow from the other physical relations confirms the fact that the condition of constant radial fatigue leads to the selection of the highest values for such peripheral loads and speeds that can be actually used.

Let f'_0 be the tangential fatigue of the metal at the junction of the body of the disk and the hub. If we write

$$\frac{4}{15}(F - f'_0)r_0 = p$$

$$\frac{4}{3}F = q$$

the preceding condition leads to the following formulæ:

$$t = q - \frac{p}{r} \quad \ldots\ldots\ldots\ldots\ldots\ldots [3]$$

$$t' = q - \frac{4p}{r} \quad \ldots\ldots\ldots\ldots\ldots\ldots [4]$$

$$\frac{1}{A} L\,(zt^4) + \frac{r^2}{q^3}\left(t - \frac{q}{2}\right) + \frac{p^2}{q^3} L(rt) = C^{te} \ldots\ldots [5]$$

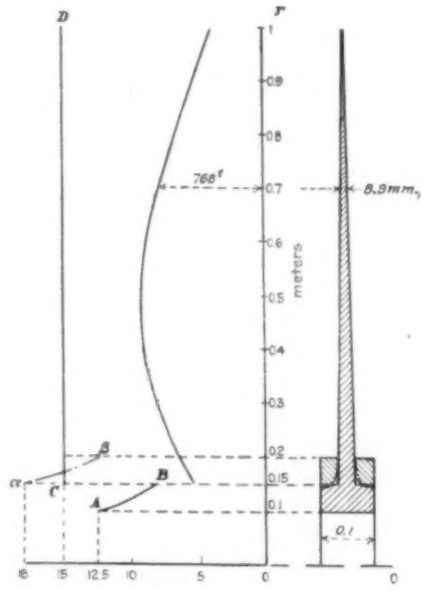


FIG. 20 SECTION OF DISK WITH HUB EQUIPPED WITH COLLAR (CURVE $\alpha\,\beta$ SHOWS FATIGUE IN COLLAR)

If in this last equation one makes $t = t'$ and hence $p = 0$, then, as may be proved easily, the equation reduces to the well-known formula of equal resistance disks, namely,

$$L\frac{z}{z_0} + \frac{A}{2t}(r^2 - r_0^2) = 0$$

The third item of the first member of this equation can be neglected under ordinary conditions, so that the equation takes the following practical form:

$$L(zt^4) + A\frac{r^2}{p^3}\left(\frac{3}{2}q - t\right) = C^{te}$$

Formulæ [1] and [2] on one hand, and [3] and [4] and [5] on the other, are sufficient for handling all numerical examples. As a rule, a large coefficient of safety should be provided in the selection of a value for F.

The use of shrunk-on collars on the hub makes it possible to extend materially the actual limits of stresses and peripheral velocities. To prove this the writer investigates the three disks shown in section by Figs. 17, 19 and 20. The hubs in Figs. 17 and 19 are of the usual type and differ in height according to the radius. The hub in Fig. 20 is similar to that in Fig. 17, but equipped with collars which raise its volume to that of Fig. 19.

All three are of the same width (100 mm.), same bore (200 mm.) and the same speed (3000 r.p.m.).

The writer selects for F a value of 15 kg. for the body of the disk, the steel used having the characteristics $R = 90$ kg., $E = 60$ kg., elongation 15 per cent. The fatigue in the bore of the hub is limited to 12.5 kg. because of the additional local stresses due to the presence of the key and also in view of the grave nature of accidents that might occur as the result of a crack in the hub. For the disk collars shown in Fig. 19 the maximum fatigue of 18 kg. would be moderate, because the presence of latent stresses is but hardly likely in these pieces of uniform thickness, and for them may be used a steel having

an elongation slightly lower than that of the disk and a tensile strength of, say, 100 kg.

Disk Shown in Fig. 17. Assume that in the bore $t = 0$ and $f' = t' = 12.5$. The constants a and b of Equations [1] and [2] are then found to be as follows: $a = 6.5$ and $b = 0.62$. These equations give us the stresses t and t' and the main fatigues $f = t - t'/4$ and $f' = t' - t/4$ of the hub along various radii.

Only the greater of these two main fatigues is of interest, namely f', the value of which is given by the curve AB. At the periphery of the hub where $r = 0$ or 0.15, it is found that $f' = 8.1$ kg. and $t = 3.03$.

In passing now to the body of the disk, it is found that the circular fibers in proximity to the hub and disk undergo the same elongation and are therefore subject to the same fatigue. The condition $f'_o = t' - t/4 = 8.1$, together with the arbitrary relation $F = t - t'/4 = 15$ kg. (straight line CD), determines the magnitudes of t and t'.

The radial stress thus found, viz., $t = 18.16$ kg., must be equal to the stress 3.03 kg. in the hub at its periphery, and hence the thickness z at the origin of the body of the disk is:

$$z = 100 \times 3.03 / 18.16 = 16.7 \text{ mm.}$$

Equations [3], [4], and [5] become then respectively:

$$t = 20 - 0.276/r$$
$$t' = 20 - 1.104/r$$
$$\log (zt^4) + 0.086\, r^2 (30 - t) = 6.281$$

These equations completely determine the disk and the tensile stresses present therein. The load permissible at the periphery of the disk for a radius r is $2\pi rzt$ tons (the heavy-line curve, unit abscissa equal to 100 tons).

In the particular case considered above, with $r = 0.7$, the above equations give $t = 19.605$ kg., $z = 4.71$ mm., and 405 tons as the limit peripheral load. This load is considerably below the 750 tons which was thought to be necessary. The first thought would be to increase all thicknesses in the ratio 750/405 in order to obtain the desired resistance, but a simple scale sketch of the hub shows that this cannot be done because such a sketch makes it patent that the external parts are incapable of lending real support to the radial stresses in the disk, as shown by Fig. 18. Other stresses likewise limit the permissible length of the hub; thus one cannot with impunity increase indefinitely the turbine shaft, this latter being all the time under load and subject to rapid rotation (cp. *Revue de Mécanique*, June 1903).

Disk Shown in Fig. 19. One might attempt, in order to increase the resistance of the hub, to increase its height in the radial direction. As a matter of fact, the increase in the resistance amounting to about 20 per cent is secured through doubling the height of the hub, but such an increase of resistance is still quite insufficient and it cannot be increased further by employing a still higher hub.

Disk Shown in Fig. 20. The reason why fatigue cannot be materially reduced by increasing the height of the hub appears from an examination of curve AB in Fig. 19. This is because the added metal does not perform any work. Its maximum fatigue remains between the limits 6.5 kg. and 8 kg., and does not exceed that due to the centrifugal force of the hub structure itself.

The writer had the idea of substituting for this metal, which is only poorly utilized, metal which would work at its maximum efficiency. This result can be secured by adding to the hub of Fig. 17 collars placed with an initial, properly regulated compression. (Cf. British Patent No. 11849, in the year 1917.) The diagram in Fig. 20 shows that since metal added in the above manner is subject to a fatigue of from 12 to 18 kg., the peripheral load which may be applied to the disk at the radius, equal to 0.7 m., is as high as 768 tons.

In this case the compression stress exerted by the collar on the hub is 3.94 kg. and the thickness of the disk at its origin is 31.5 mm.

Still better results could be obtained by means of superimposed collars.

There was an impression that the present lack of certain special steels might hinder the construction of turbines having a large specific output. The preceding discussion shows, however, that when judiciously employed, ordinary good steel is amply sufficient for all present needs. (*La turbine à vapeur de grande puissance spécifique et les disques à moyeu fretté*, Maurice Delaporte, *La Technique Moderne*, vol. X, no. 3, March 1918, pp. 126-129, 7 figs., *tpA*)

Testing Materials

SOME EXPERIMENTS ON NOTCHED BARS, Captain Philpot. The paper describes a large number of experiments, the primary object of which was to obtain suitable dimensions and shape for a round notched-bar test piece, which could be used in acceptance tests on heat-treated steels in place of the standard square test piece. Under present conditions the pressure on milling and shaping machines is such that it appeared desirable, if possible, to remove the machining of notched-bar test pieces from such machines, and the first object in view when the experiments were started was to obtain a type of test piece which could be produced entirely by machining in an ordinary lathe.

Briefly put, Captain Philpot has met with considerable success, and a round test piece has been evolved which fulfils the conditions with sufficient accuracy for the purpose in view, the test piece being produced entirely by machining in a lathe, the notch being made by turning in an eccentric mandrel. This eccentric mandrel, however, has one disadvantage, in that it must turn through 360 deg., and the machining of the test piece takes place during but about 24 deg. of this motion. This objection, however, is partly overcome by mounting four test pieces in the mandrel, but an alternative method has been devised in which the notches in the round test piece can be milled or shaped, in place of turning them in the eccentric mandrel.

The experiments naturally carried Captain Philpot to other considerations than the mere round test piece, and the following conclusions which he came to indicate fairly well their nature:

1 Round test pieces (of types illustrated in the original paper) are sufficiently good approximations to the standard square test piece for use in acceptance tests on steel where facilities for machining the square test piece are lacking or insufficient.

2 Notched-bar test pieces, with relatively large radii at the roots of the notches, are insensitive, and are therefore unsatisfactory.

3 The tensile test, even where an extensometer is used, does not give any satisfactory criterion for detecting the condition of the material, which gives low values on the notched-bar tests.

4 The notched-bar test, made on a pendulum testing machine, is not *essentially* an impact test.

5 The notched-bar test may be made in either the Charpy or the Izod pendulum machines, and should give similar values except for very tough specimens. This similarity could prob-

ably be increased even for the higher values if the span for the 10-mm.-sq. test pieces were made 44 mm. instead of 40 mm., or the length of the Charpy specimen reduced, so that the specimens which were not entirely broken through were bent to the same included angle as in the Izod machine.

A point of importance brought out in the discussion was the view of the practical man of the value of the impact test. The matter was first raised by Commander Jenkins, who contended that the impact value of a steel has no direct value in designing, for instance, a crankshaft, and that we do not understand the relationship between elongation and impact value in regard to the factors which really govern the strength and the useful properties of a steel in a crankshaft. He thought it possible that elongation was some index of the fatigue range, and that probably the Izod figure was some indication of the rate at which minute cracks will extend in the shaft. At the same time he thought it was safe to assume that a high Izod test had a value.

Dr. T. E. Stanton said that the few cases at the National Physical Laboratory during the past four or five years in which failure had occurred through faulty heat treatment, were shown definitely by the impact test. He did not think the mere fact that one only had a lathe need prevent the use of the square test piece, and he sketched a device used at the National Physical Laboratory which enabled square specimens to be prepared by boy labor in twenty minutes.

Mr. H. W. Dickenson called attention to the fact that the bulk of Captain Philpot's work was with nickel-chrome steels. That fact should be borne in mind, because the impact test did not, in the same precise way, pick out the undesirable variations in the heat treatment when dealing with carbon steel as it did with nickel-chrome steels. His firm used the round test piece, and in the test house and workshops a preference was expressed for it. It was found to be easier to machine and easier and quicker to make. However, the trouble was that the impact test did not enable us to tell from the microstructure the quality of the steel. Take a piece of nickel-chrome steel, oil-harden it at 1000 deg. cent., temper it at 620 deg., and quench in water; take another piece of steel from the same bar and oil-harden it at 800 deg., quench at 620 deg., and very slowly cool, and very different results would be obtained. Most of them, a few years ago, would have said the second piece would give a good steel and the first one not, but the Izod test would give, say, 50 ft-lb. for the first one, while the second one, which gave a beautifully fine grain structure, would show about 15 ft-lb. He would not attempt to explain what it was that caused the difference, although he had a feeling that it was connected with the bonding between the crystals.

Mr. A. A. Remington did not think the author's round test piece was any improvement on the standard square piece from the point of view of enabling the properly heat-treated specimen to be sorted from the improperly treated one. He did not think the round test piece was easier to machine. So far as the value of the test piece was concerned, he contended that it represented the testing of materials under abnormal conditions. While all engineering structures had shoulders and corners, they were not usually designed so that they ripped right across at one blow. What it was desirable to know was the sort of notch or shoulder that could be put with safety in a material of a known tensile strength without risk and failure by fracture or fatigue. While the notched-bar test gave some information, the correlation between it and what the designer might safely put in was not very obvious to him.

Mr. T. Flather agreed with the views put forward by Mr. Remington. He had always felt that as far as possible physical tests should follow the definite requirements of the engineer and the designer; the notched-bar test, whatsoever its form, did not do so. What was there to prevent the adoption of an impact test piece which, while it had no notch on it, approximated very nearly to some of the things that were required in engineering practice?

Dr. W. H. Hatfield, speaking on the same point, said that if the tests were applied to carbon as to nickel steels, the carbon steels would be shown to be very brittle. Clearly, there was an explanation, and the obvious one was that a steel of 10 ft-lb., provided its elastic limit, yield, maximum stress, reduction of area and elongation were all right, was not a brittle steel. He would undertake to fly to Paris and back next week in an aeroplane that had a crankshaft with an impact value not exceeding 10 ft-lb. The fact was that large tonnages of steel used for the most vital purposes had values which would shock some people, yet these steels were faithfully fulfilling their functions under most stringent conditions; hence they could not be brittle. He had examined many failures, and had met with steels that had failed badly which had an impact value of 60 ft-lb. (Paper before Society of Automobile Engineers (British), read on April 10, 1918; abstracted through *The Engineer*, vol. 125, no. 3251, April 19, 1918, p. 338, *eA*)

Thermodynamics

HEAT TRANSFER IN INSULATION, H. Harrison. *Refrigerating World*, vol. 53, no. 4, April 1918, pp. 11-14, 2 figs., 2 tables.

Varia

THE ENGINEER IN THE NEW DEMOCRACY, George C. Whipple. *Journal of the Boston Society of Civil Engineers*, vol. 5, no. 4, April 1918, pp. 143-162.

NOMOGRAPHY—WITH SPECIAL REFERENCE TO ITS USE IN ENGINE DESIGN, F. Leigh Martineau. *The Automobile Engineer*, vol. 8, no. 113, April 1918, pp. 103-111, 24 figs.

Charts

CHART FOR DETERMINING THE COST OF BELT SLIP. *Metallurgical and Chemical Engineering*, vol. 18, no. 8, April 15, 1918, p. 426.

CHART FOR THE DETERMINATION OF DIAMETER, VELOCITY AND LOSS OF HEAD IN PIPES. *Engineering and Mining Journal*, vol. 105, no. 15, April 13, 1918, p. 684.

CHART SHOWING PENETRATION OF CARBON, Howard Ensaw. *American Machinist*, vol. 48, no. 18, May 2, 1918, p. 756.

THERMAL EFFICIENCIES AND WATER RATE OF TURBINES WITH DIFFERENT STEAM PRESSURES, AND METHOD OF ASCERTAINING CAPITALIZED VALUE OF SAVING POSSIBLE WITH HIGHER STEAM PRESSURES, J. T. Foster. *Electrical World*, vol. 71, no. 19, May 11, 1918, p. 977, 2 charts.

CLASSIFICATION OF ARTICLES

Articles appearing in the Survey are classified as *c* comparative; *d* descriptive; *e* experimental; *g* general; *h* historical; *m* mathematical; *p* practical; *s* statistical; *t* theoretical. Articles of especial merit are rated *A* by the reviewer. Opinions expressed are those of the reviewer, not of the Society. The Editor will be pleased to receive inquiries for further information in connection with articles reported in the Survey.

LIBRARY NOTES AND BOOK REVIEWS

ARTICLES of interest from the Library of the four Founder Societies, selected list of accessions during the month, and reviews of books of special importance prepared by members of the A.S.M.E. and others particularly qualified.

Recent Gifts to the Engineering Societies Library

DURING the past twenty years the Westinghouse Electric & Manufacturing Company and the General Electric Company have collected a valuable library of some nine thousand volumes on electricity. The collection was intended especially for use in patent searches, and is particularly rich in patent material. Files of all the principal patents relating to electric light and power issued by America, England, France and Germany are present, together with copies of the patents owned or controlled by the two companies. Another feature, and one of unusual value, is a series of volumes containing the records of the important adjudicated patent causes of these companies and their predecessors during the past twenty-five years, and forming a storehouse of electrical history. There are also files of about one hundred electrical periodicals.

It is a pleasure to announce that this collection has now been presented by the owners to the Engineering Societies Library. This gift, which was arranged through Mr. Charles A. Terry, Vice-President, Westinghouse Electric & Manufacturing Company, and Mr. Charles Neave, Counsel, General Electric Company, was made with the thought that the collection would be useful to many engineers if housed in an easily accessible situation. It is an unusually valuable accession, for which the Library authorities are deeply grateful. The books have been transferred to the Engineering Societies Library, where they may now be consulted.

During April Mr. Jesse M. Smith presented nearly four hundred volumes and pamphlets selected from his private library, consisting of engineering periodicals and of records of patent causes with which Mr. Smith has been connected.

Mr. Putnam A. Bates has presented large portfolios containing a set of the drawings for the New York City fire-alarm system, which will prove interesting to engineers.

Dr. F. H. Newell has collected and presented a number of interesting publications relating to the Council of Engineering Societies on National Public Works, which was active in attempting to reform the policy governing the conduct of public works in this country during the eighties.

Space forbids the mention of many other gifts, but these have in nearly every case been of decided value to the Library, and have been appreciated also as evidence of friendly interest in its success. It is hoped that every member will bear the needs of the Library in mind and present from time to time any new or old engineering material which he can spare. General coöperation will bring to its shelves much scattered material which cannot be obtained in any other way.

HARRISON W. CRAVER,
Director of Library.

BOOK REVIEWS AND NOTES

Kinematics of Machinery. A Text-Book on Mechanisms and Their Properties, with Many Practical Applications for Engineers and for Students in Technical Schools. By Arthur Warner Klein, M.E. McGraw-Hill Book Co., Inc., New York, 1917. 1st ed. Cloth, 6x9 in., 227 pp., 120 figs. and 7 folding plates. $2.50.

The first thirty-four pages of this book present the elementary ideas about motion, and the construction and operation of mechanism. Chapter IV explains the construction of displacement diagrams; Chapters V, VI and VII, constituting seventy-four pages, discuss the graphical determination of velocities; Chapters VIII, IX and X, of fifty pages, present graphical methods for finding accelerations. Chapter XII takes up the problem of force and mass reduction, that is, the determination of a mass assumed as concentrated at a given point in the mechanism which shall give an energy condition for the system equivalent to that existing before the mass was concentrated.

Appendix A elaborates a mathematical criterion for determining if an assemblage of links is a mechanism or not. Appendix B shows how to determine velocities and accelerations by polar diagrams.

The book presents the subject of kinematics of machinery from a mathematical rather than from the engineering standpoint. The author has elaborated very completely the instant-center method of analysis, reaching a culmination in its application to governor-gear problems. This, of course, is a very narrow field, and as all useful mechanism tends toward simplicity rather than complexity, most of its problems can be solved with quite elementary analysis. Much of what is contained in the book was presented thirty years ago by Burmester in his Lehrbuch der Kinematik, but as the author says in his preface, "the study of mechanism has always been a fascinating one for mechanical engineers," and we believe the real student of mechanism will find some stimulus here in reviewing his old ideas in the light of the original contributions of the author.

ALTON L. SMITH.

Mechanical Laboratory Methods. The Testing of Instruments and Machines in the Mechanical Engineering Laboratory and in Practice. By Julian C. Smallwood, M.E., Fellow, Johns Hopkins University, Mem.Am.Soc.M.E. D. Van Nostrand Co., New York, 1918. Second edition, revised and enlarged. Flexible cloth, 5x7¼ in., 399 pp., 114 illustrations. $3 net.

A second edition of this compact work on the broad principles of experimental apparatus and methods having been called for, the author has taken the opportunity afforded to make certain additions to the text. These include matter on the testing of condensers, feedwater heaters, ammonia absorption and compression refrigerating systems, and the horsepower output of electric motors; steam and ammonia tables, a Mollier diagram and tables of areas of circles, four-place logarithms and densities of water. The section on instruments has been enlarged to comprise recording apparatus, the treatment of valve setting and steam-engine testing has been extended and improved, and a section on hygrometry has been added. In the previous edition there appeared in print for the first time descriptions of a number of testing methods, among

them being a method of setting the slide valve by the Bilgram diagram, the application of the method of least squares to indicator-spring calibration, methods originated by the author for testing indicator-drum motion and reducing wheels, etc.

Finding and Stopping Waste in Modern Boiler Rooms. Compiled by George H. Gibson, Mem.Am.Soc.M.E., assisted by Capt. Percy S. Lyon, Jun.Am.Soc.M.E. Harrison Safety Boiler Works, Philadelphia, Pa., 1918. Linen, 4¾x7 in., 270 pp., 213 illustrations. $1 net.

This valuable and timely reference manual, designed "to aid the owner, manager and boiler-room operator in securing and maintaining plant economy," is a compilation of statements, tables and charts from a wide variety of sources, among which are the TRANSACTIONS of the Society, the publications of the U. S. Bureau of Mines and the files of technical periodicals. The work is divided into five sections dealing respectively with fuels, combustion, heat absorption, boiler efficiency and boiler testing, and boiler-plant proportioning and management. It is stafed that only such material as is supported by the results of experiments and tests has been selected, and that statements of different authorities have been carefully compared and each source of information checked against others.

Efficiency Methods. By M. McKillop, M.A., and A. D. McKillop, B.Sc. (Eng.), C.E. D. Van Nostrand Co., New York, 1917. Cloth, 5x7 in., 215 pp., 6 illustrations. $1.50 net.

A brief but reasonably comprehensive statement of the principles and aims of modern American methods of shop management, which the authors believe should be brought to the attention of all those with position and influence in British industry. The information given has been obtained from authoritative literature on the subject and from observation of the Taylor system in operation, and the book is written from the standpoint of those who have worked under that system and have been very favorably impressed with its effectiveness.

Theories of Energy. By Horace Perry. G. P. Putnam's Sons, New York and London, 1918. Cloth, 5x7¼ in., 231 pp., 4 diagrams. $1.75 net.

During the past twenty years the author has made a study of the various manifestations of energy, and the results of his thoughts and investigations are set forth in this book. A new theory of color is advanced which, it is stated, clears up a number of points not previously understood.

Agricultural Bacteriology. By H. W. Conn. 3rd ed. Revised by H. J. Conn. A Study of the Relation of Germ Life to the Farm with Laboratory Experiments for Students. Microorganisms of Soil, Fertilizers, Sewage, Water, Dairy Products, Miscellaneous Farm Products and of Diseases of Animals and Plants. P. Blakiston's Son & Co., Philadelphia (copyright 1918). Cloth, 6x8 in., 357 pp., 63 illus. $2.

The third edition has been brought up to date by the inclusion of the advances in bacteriological knowledge since the previous edition.

Aircraft Mechanics Handbook. By Fred H. Colvin. 1st ed. A Collection of Facts and Suggestions from Factory and Flying Field to Assist in Caring for Modern Aircraft. McGraw-Hill Book Co., Inc., New York, 1918. Flexible cloth, 5x7 in., 402 pp., 193 illus., 28 tables. $3.

A manual of the best practice in inspecting, adjusting and repairing airplanes, prepared for use by the machinists and riggers who are now being trained. Describes the construction, erection and testing of the planes, the various engines in use and the methods of caring for them. An account of the Canadian training camp at Borden is also given. Useful tables and a glossary are included.

Artificial Dye-Stuffs. By Albert R. J. Ramsey and H. Claude Weston. Their Nature, Manufacture, and Uses. E. P. Dutton & Co., New York, 1917. Cloth, 6x9 in., 212 pp., 24 illus. $1.60.

A brief introductory work on the artificial dye-stuff industry, written for students and business men with little knowledge of organic chemistry, in which the industrial processes of the manufacture of dyestuffs and the nature of the substances used are explained at some length.

Aviation Chart. By Victor W. Pagé. Location of Airplane Power Plant Troubles Made Easy. The Norman W. Henley Publishing Co., New York. 1918. Paper, 32x46 in. $.50.

A large chart outlining all parts of a typical airplane power plant, showing the points where trouble is apt to occur and suggesting remedies for the common defects. Intended especially for aviators and aviation mechanics on school and field duty.

Coal Gas Residuals. By Frederick H. Wagner. 2nd ed. Revised and enlarged. McGraw-Hill Book Co., Inc., New York, 1918. Cloth, 6x9 in., 244 pp., 45 illus., 12 pl. (10 folded), 7 diag., 32 tab. $2.50.

The chief additions to this edition discuss the process of tar distillation and tar products, and give further information on the product derived from spent oxide, the production of nitric acid, naphthalene, benzol and toluol. A chapter on the manufacture of sulphuric acid from spent oxide has also been added, and the typographical errors in the first edition have been corrected.

Cold Drawn Steel. Issued by the Peerless Drawn Steel Co. Bar Weights of Rounds, Flats, Hexagons, and Squares; Weight Tables for Plates; Metric Conversion Tables (Cover Title—Book of Weights). The Peerless Drawn Steel Co., Massillon, 1918. Flexible leather, 5x8 in., 145 pp., 52 tab. $3.

Instead of giving only the weight per foot of steel bars of various sizes, this book gives the totals for bars of all the usual lengths in feet. A number of other useful tables are added.

Complete List of Base Prices, Differentials and Extras on Iron, Steel and Non-Ferrous Products. Fixed under Government Supervision. Penton Publishing Co., Cleveland (copyright 1918). Paper, 6x8 in., 42 pp. $2.

A convenient summary of the Government prices. Prepared by the *Iron Trade Review* and presented to subscribers to that journal.

Creating Capital. By Frederick L. Lipman. Money-Making as an Aim in Business. Houghton Mifflin Co., New York, 1918. Cloth, 5x7 in., 71 pp., $0.75.

Higher Education and Business Standards. By Willard Eugene Hotchkiss. Houghton Mifflin Co., New York, 1918. Cloth, 5x7 in., 199 pp. $1.

Two essays delivered at the University of California on the Weinstock Foundation, established for the discussion of the various phases of the moral law in its bearing on business life under the new economic order.

Electrical Measurements. By O. J. Bushnell and A. G. Turnbull. A Practical Handbook Covering the Design and Construction of Measuring Instruments and their Uses in Measurement of Current, Resistance, and Commercial Power, with Special Reference to Watt-hour and Maximum Demand Meters. American Technical Society, Chicago, 1914. Cloth, 6x8 in., 171 pp., 139 illus., 2 pl. $1.

The authors' aim has been to supply an adequate description of the instruments and methods used for the measurement of electrical energy, and to show by diagrams exactly how meters should be connected under all conditions.

Electrodynamic Wave-Theory of Physical Forces. By T. J. See. Announcing the Discovery of the Physical Cause of Magnetism, of Electrodynamic Action, and of Universal Gravitation. Vol. 1, Bulletins 1 to 6 inclusive. Thomas P. Nichols & Son Co., Lynn, Mass., 1917. Paper, 10x12 in., 158 pp., 21 diag., 4 pl., 1 chart, 6 tab. (1 folded). $5.

In these bulletins Dr. See presents his hypothesis that mag-

netism, electrodynamic action and universal gravitation are due to waves propagated with the velocity of light through the free ether and at slower rates through solid masses. The author believes that his investigations have finally solved the problem of the nature and mode of propagation of physical forces.

Field Artilleryman's Guide. 3-in. Gun, 4.7- and 6-in. Howitzer. Prepared by the Officers of the 108th (2d Pa.) Field Artillery. 2d revised ed. P. Blakiston's Son & Co., Philadelphia (copyright 1918). Cloth, 4x7 in., 381 pp., 108 illus., 3 pl., 31 tab. $1.75.

A pocket guide intended to serve the immediate needs of field artillerymen in the United States Army by presenting the fundamentals of their duties.

Forging. By John Jernberg. Manual of Practical Instruction in Hand Forging of Wrought Iron, Machine Steel, and Tool Steel; Drop Forging; and Heat Treatment of Steel, Including Annealing, Hardening and Tempering. American Technical Society, Chicago, 1917. Cloth, 6x8 in., 131 pp., 206 illus., 2 pl., 3 tab. $1.

A concise account, intended primarily for students. Describes the methods and tools used in hand forging, as well as the usual shop practice in hardening, annealing and tempering steel.

Galvanizing and Tinning. By W. T. Flanders. A Practical Treatise on the Coating of Metal with Zinc and Tin by the Hot Dipping, Electro Galvanizing, Sherardizing and Metal Spraying Processes, with Information on Design, Installation and Equipment of Plants. David Williams Co., New York, 1916. Cloth, 6x9 in., 350 pp., 142 illus., 3 charts, 5 tab. $4.

Discusses the various processes in a practical way, describing the machinery, materials and operations in detail. Intended as a guide in the installation and operation of galvanizing and tinning plants.

Handbook of Hydraulics for the Solution of Hydraulic Problems. By Horace William King. 1st ed. McGraw-Hill Book Co., New York, 1918. Flexible cloth, 4x7 in., 424 pp., 91 illus., 112 tab., 2 diagrams. $3.

The author has attempted to simplify the work of the hydraulic engineer by studying critically the empirical formulæ which have been devised and selecting those which are of value. These are presented with a description of their limitations and are accompanied by the necessary tables of coefficients. The twofold purpose of securing an accuracy consistent with the best experiments and of simplifying calculations has been kept in mind throughout the book.

Internal-Combustion Engine Manual. By F. W. Sterling. 4th ed. R. Beresford, Washington, 1917. Cloth, 6x10 in., 168 pp. $2.

This manual, representing the course on internal-combustion engines given at the U. S. Naval Academy, has been rewritten, enlarged and brought up to date. It now covers the theory and practice of these engines without including mathematical demonstrations and formulæ. Particular attention is given to the engines used by the Navy and to aviation engines.

Manual of Military Aviation. By Hollis Leroy Muller. Prepared for the use of Personnel of Aircraft Troops of the Army, National Guard and Reserve Corps; Members of Military Training Camps; and Airmen in General. George Banta Publishing Co., Menasha, Wis. (copyright 1917). Cloth, 5x8 in., 308 pp., 38 illus. $2.50.

Contains the theoretical information necessary for efficient military aviation service. Intended for use as a textbook and as a reference work.

Machine Shop Practice. By William B. Hartman. D. Appleton & Co., New York, 1917. Cloth, 5x7 in., 247 pp., 141 illus., 4 pl., 10 tab. $1.10.

A presentation of the elementary principles of machine-shop practice, intended for the instruction of beginners. Mathematical calculations are confined to the use of simple arithmetic.

Mechanics of the Household. By E. S. Keene. A Course of Study Devoted to Domestic Machinery and Household Mechanical Appliances. McGraw-Hill Book Co., New York, 1918. Cloth, 6x8 in., 391 pp., 273 illus., 11 tab. $2.50.

This book is intended to be a presentation of the physical principles and mechanism employed in the equipment that has been developed for domestic convenience. Equipment for heating, ventilating, water supply, sewage disposal, lighting, etc., is described.

Metallurgical Calculations. By Joseph W. Richards. McGraw-Hill Book Co., Inc., New York, 1918. Cloth, 7x10 in., 698 pp., tab. $5.

A convenient one-volume edition of the work, in which errors occurring in earlier ones have been corrected and new physical and chemical data have been added.

Power Stations and Transmission. By George C. Shaad. A Comprehensive Treatise on Electric Power-Station Equipment, Design and Management, and the Erection and Maintenance of Proper Transmission Lines. American Technical Society, Chicago, 1917. Cloth, 6x8 in., 180 pp., 50 illus., 3 pl., 10 tab. $1.

Presents concisely the important features of the topic. The treatment is largely descriptive and non-mathematical.

The Principles, Operation and Products of the Blast Furnace. By J. E. Johnson, Jr., 1st ed. McGraw-Hill Book Co., New York, 1918. Cloth, 6x9 in., 551 pp., 173 illus., 23 tab. $5.

A thorough, detailed discussion of the operation of the blast furnace, including both the theoretical principles and the practice of the present day. Completes the author's treatise on the manufacture of pig-iron, begun in his work entitled Blast Furnace Construction.

The Principles of Sanitary Tactics. By Edward Lyman Munson. A Handbook on the Use of Medical Department Detachments and Organizations in Campaign. George Banta Publishing Co., Menasha, Wis. (copyright 1917). Cloth, 5x8 in., 305 pp., 13 maps, including two folded maps in cover. $2.15.

The author's desire has been to provide a text book which will standardize the methods of instructing line and medical officers in the tactical use of the sanitary service with troops in campaign, and will also give a thorough grounding in the fundamentals of sanitary tactics as a whole.

Radio Telephony. By Alfred N. Goldsmith. The Wireless Press, Inc., New York (copyright 1918). Cloth, 6x9 in., 247 pp., 226 illus. $1.25.

The author has attempted in this work to give a full description of present methods of radio telephony and of the various types of apparatus employed. The first systematic exposition of the subject to appear since 1907.

The Science of Management. By Frederick A. Parkhurst. Published by the Author, Cleveland (copyright 1918). Cloth, 6x9 in., 203 pp., 7 tab. $3.

A textbook prepared to accompany the author's course of thirty lectures, delivered during 1917-18 at the Case School of Applied Science.

A Short Handbook of Oil Analysis. By Augustus H. Gill. 8th ed., revised. J. B. Lippincott Co., Philadelphia, (copyright 1918). Cloth, 5x8 in., 209 pp., 9 illus.

This well-known manual is designed to provide a concise account of the methods of applying the usual physical and chemical tests to oils. The eighth edition has been revised, descriptions of some new forms of apparatus included and some minor tests and new methods added.

Technical Mechanics. By Edward R. Maurer. Statics and Dynamics. 4th ed., revised and enlarged. John Wiley & Sons, Inc., New York, 1917. Cloth, 6x9 in., 381 pp., 178 illus. $2.50.

A theoretical mechanics written for students of engineering, in which each subject discussed has a direct bearing on some engineering problem. The book thus differs from those commonly called theoretical mechanics, and is, on the other hand,

dissimilar to books commonly entitled applied mechanics. The fourth edition has in addition 176 more problems and the modification of the articles on axle reactions, efficiency of machines, hoists, gyrostats kineties of plane motion, rolling resistance, kineties of a body with a fixed point, and the dynamics of any motion of a rigid body.

Text Book of Advanced Machine Work. By Robert H. Smith. 4th ed. Revised and enlarged. Prepared for Students in Technical, Manual Training, and Trade Schools, and for the Apprentice and Machinist in the Shop. Industrial Education Book Co., Boston (copyright 1916). Cloth, 5x8 in., 648 pp., 680 illus., 44 tab. $3.

A continuation of the author's Principles of Machine Work. This volume treats of engine-lathe work, drilling and boring machines, grinding, planing, milling, gear cutting and tool making. Careful explanations are given in each case.

War Administration of the Railways in the United States and Great Britain. By Frank Haight Dixon and Julius H. Parmelee. Carnegie Endowment for International Peace, Division of Economics and History. Preliminary Economic Studies of the War. Oxford University Press, New York, 1918. Paper, 7x10 in., 155 pp. $1.

An account of the methods used in the two countries and of the results achieved prior to December, 1917, during the period when the American railways were voluntarily coöperating with each other. The authors present a simple narrative, without attempting to draw conclusions.

War-Time Control of Industry. The Experience of England. By Howard L. Gray.. The Macmillan Co., New York, 1918. Cloth, 5x8 in., 307 pp. $1.75.

A summary of the development and status of governmental control of industry in Great Britain, arranged to show its successive stages. Part of the information was collected for the Commercial Economy Division of the Council of National Defense. The book concludes with a comparison of English and American experience.

The Petroleum and Natural Gas Register. A Directory of the Petroleum and Natural Gas Industries in the United States, Canada and Mexico. The Oil Trade Journal, New York, 1917-1918. Cloth, 9x12 in., 548 pp. $12.

This work is based on statements made by officials of the companies listed, and gives the usually needed information as to properties, capital stock, officers, etc. The price includes an annual subscription to the *Oil Trade Journal*, in each issue of which supplemental data are to be published.

LIBRARY ACCESSIONS

AIRPLANE BUILDING. List of books in collection of Brooklyn Public Library, January 1918. *Brooklyn, 1918.* Gift of Brooklyn Public Library.

ALCOHOL AS A SOURCE OF POWER. (South Australia. Dept. of Chemistry. Bulletin No. 8.) *Adelaide, 1917.* Gift of South Australia Dept. of Chemistry.

APPARENT DIELECTRIC STRENGTH OF VARNISHED CAMBRIC. By A. E. Kennelly and R. J. Wiseman. Reprinted from *Electrical World*, Dec. 15, 1917. Gift of Massachusetts Institute of Technology, Electrical Engineering Dept.

ASCERTAINMENT OF MACHINERY VALUES AND LOSSES. Read before the Insurance Society of New York, Jan. 11, 1916. By John Hankin. Gift of Insurance Society of New York.

BOLIVIA, THE REPUBLIC OF—OFFICIAL INFORMATION AND STATISTICS, SUMMARIZED BY JULIO ZAMORA. *New York, n. d.* Gift of Bolivia, Minister of Foreign Relations.

CALIFORNIA RAILROAD COMMISSION. Opinions and Orders, Dec. 1, 1916-March 31, 1917. vol. XII. *Sacramento, 1917.* Purchase.

CHAMBER OF COMMERCE OF THE UNITED STATES OF AMERICA. Year Book, 1917. *Washington, 1917.* Gift of Chamber of Commerce.

THE CHEMICAL CONSTITUTION OF THE PROTEINS. By R. H. A. Plimmer. Part 1, Analysis. Longmans, Green and Co., *New York, 1917.* Boards, 6 x 10 in., 174 pp., 7 illus., $1.80. Gift of the publishers.

CHEMISTRY OF LINSEED OIL. By J. Newton Friend. *London, 1917.* Purchase.

COTTON PRODUCTION AND DISTRIBUTION, 1916-17. U. S. Bureau of the Census, Bulletin 135. *Washington, 1918.* Purchase.

CURTISS STANDARD JN4-B MILITARY TRACTOR. Handbook, 1917.

CURTISS STANDARD MODEL V-2 AERONAUTICAL MOTOR. Handbook, 1917.

CURTISS STANDARD MODEL OX AERONAUTICAL MOTOR. Handbook, 1918.

CURTISS STANDARD MODEL OX 5 AERONAUTICAL MOTOR. Parts list. *Buffalo, 1917-18.* Gift of Curtiss Aeroplane & Motor Corporation.

DESIGN AND CONSTRUCTION OF INDUSTRIAL BUILDINGS. By Moritz Kahn. *London, 1917.* Purchase.

DUST EXPLOSIONS AND FIRES IN GRAIN SEPARATORS IN THE PACIFIC NORTHWEST. (U. S. Dept. of Agriculture. Bulletin No. 379.) *Washington, 1916.* Purchase.

THE EXAMINATION OF MILK FOR PUBLIC HEALTH PURPOSES. By Joseph Race. John Wiley & Sons, Inc. *New York, 1918.* Cloth, 5 x 8 in., 224 pp., 4 illus., $1.75. Gift of the Publisher.

FACTOR OF SAFETY OF WIRE ROPES USED FOR WINDING IN MINE SHAFTS. By J. A. Vaughan. Reprinted from the *Journal of the South African Institution of Engineers*, Nov. 1917. Gift of author.

FOAMING OF BOILER WATERS. (South Australia. Dept. of Chemistry. Bulletin No. 5.) *Adelaide, 1917.* Gift of South Australia, Dept. of Chemistry.

FREIGHT HANDLING AND TERMINAL ENGINEERING. Vol. 2; 3; Vol. 4, No. 1. *New York, 1916-18.* Gift of H. McL. Harding.

FRESH WATER BIOLOGY. By Henry Baldwin Ward and George Chandler Whipple with a collaboration of a staff of specialists. John Wiley & Sons, Inc. *New York, 1918.* Cloth, 6 x 9 in., 1111 pp., 1547 illus., $6. Gift of the publisher.

THE GERMAN UNION OF TECHNICAL AND SCIENTIFIC SOCIETIES. By Sir Robert Hadfield. *January, 1918.* Gift of Sir Robert Hadfield.

GOLD DEPOSITION IN THE BENDIGO GOLD FIELD, THE FACTORS INFLUENCING AUSTRALIAN. Advisory Council of Science and Industry. Bulletin No. 4. *Melbourne, 1917.* Gift of Advisory Council of Science & Industry.

GREAT BRITAIN. DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH ADVISORY COUNCIL. Report on the sources and production of iron and other metalliferous ores used in the iron and steel industry. *London, 1918.* Gift of A. D. Flinn.

HEAT TREATMENT OF HIGH SPEED STEEL. By Garnet W. McKee. Ed. 3. *n. p. n. d.* Gift of Eclipse Fuel Engineering Company.

HEAT TREATMENT OF STEEL IN GAS FURNACES. By Garnet W. McKee. Ed. 4. *Rockford, Ill., 1918.* Gift of Eclipse Fuel Engineering Company.

HELICOPTER FLYING MACHINE. By J. Robertson Porter. *London, 1911.* Purchase.

HOW BALTIMORE MANUFACTURERS CAN DO BUSINESS WITH THE GOVERNMENT. SUGGESTIONS AND INFORMATION. Gift of the Civic and Industrial Bureau of the Merchants and Manufacturers Association.

HYDRAULIC TURBINES. I. P. Morris Company, Hydraulic Dept. Bulletin No. 4. The William Cramp & Sons Ship & Engine Building Co. *Philadelphia, 1915.* Gift of F. H. Rogers.

HYDROMETRIC SURVEYS (STREAM MEASUREMENTS) FOR 1916. Canada. Department of the Interior. *Ottawa, 1917.* Gift of Department of the Interior.

INDUSTRIAL PLANT CONSTRUCTION. *Buffalo, 1918.* Gift of The John W. Cowper Company.

INDUSTRIAL RESEARCH IN CANADA. By J. C. McLennan. *Toronto, 1916.* Gift of Royal Canadian Institute.

netism, electrodynamic action and universal gravitation are due to waves propagated with the velocity of light through the free ether and at slower rates through solid masses. The author believes that his investigations have finally solved the problem of the nature and mode of propagation of physical forces.

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This manual, representing the course on internal-combustion engines given at the U. S. Naval Academy, has been rewritten, enlarged and brought up to date. It now covers the theory and practice of these engines without including mathematical demonstrations and formulæ. Particular attention is given to the engines used by the Navy and to aviation engines.

Manual of Military Aviation. By Hollis Leroy Muller. Prepared for the use of Personnel of Aircraft Troops of the Army, National Guard and Reserve Corps; Members of Military Training Camps; and Airmen in General. George Banta Publishing Co., Menasha, Wis. (copyright 1917). Cloth, 5x8 in., 308 pp., 38 illus. $2.50.

Contains the theoretical information necessary for efficient military aviation service. Intended for use as a textbook and as a reference work.

Machine Shop Practice. By William B. Hartman. D. Appleton & Co., New York, 1917. Cloth, 5x7 in., 247 pp., 141 illus., 4 pl., 10 tab. $1.10.

A presentation of the elementary principles of machine-shop practice, intended for the instruction of beginners. Mathematical calculations are confined to the use of simple arithmetic.

Mechanics of the Household. By E. S. Keene. A Course of Study Devoted to Domestic Machinery and Household Mechanical Appliances. McGraw-Hill Book Co., New York, 1918. Cloth, 6x8 in., 391 pp., 273 illus., 11 tab. $2.50.

This book is intended to be a presentation of the physical principles and mechanism employed in the equipment that has been developed for domestic convenience. Equipment for heating, ventilating, water supply, sewage disposal, lighting, etc., is described.

Metallurgical Calculations. By Joseph W. Richards. McGraw-Hill Book Co., Inc., New York, 1918. Cloth, 7x10 in., 698 pp., tab. $5.

A convenient one-volume edition of the work, in which errors occurring in earlier ones have been corrected and new physical and chemical data have been added.

Power Stations and Transmission. By George C. Shaad. A Comprehensive Treatise on Electric Power-Station Equipment, Design and Management, and the Erection and Maintenance of Proper Transmission Lines. American Technical Society, Chicago, 1917. Cloth, 6x8 in., 180 pp., 50 illus., 3 pl., 10 tab. $1.

Presents concisely the important features of the topic. The treatment is largely descriptive and non-mathematical.

The Principles, Operation and Products of the Blast Furnace. By J. E. Johnson, Jr., 1st ed. McGraw-Hill Book Co., New York, 1918. Cloth, 6x9 in., 551 pp., 173 illus., 23 tab. $5.

A thorough, detailed discussion of the operation of the blast furnace, including both the theoretical principles and the practice of the present day. Completes the author's treatise on the manufacture of pig-iron, begun in his work entitled Blast Furnace Construction.

The Principles of Sanitary Tactics. By Edward Lyman Munson. A Handbook on the Use of Medical Department Detachments and Organizations in Campaign. George Banta Publishing Co., Menasha, Wis. (copyright 1917). Cloth, 5x8 in., 305 pp., 13 maps, including two folded maps in cover. $2.15.

The author's desire has been to provide a text book which will standardize the methods of instructing line and medical officers in the tactical use of the sanitary service with troops in campaign, and will also give a thorough grounding in the fundamentals of sanitary tactics as a whole.

Radio Telephony. By Alfred N. Goldsmith. The Wireless Press, Inc., New York (copyright 1918). Cloth, 6x9 in., 247 pp., 226 illus. $1.25.

The author has attempted in this work to give a full description of present methods of radio telephony and of the various types of apparatus employed. The first systematic exposition of the subject to appear since 1907.

The Science of Management. By Frederick A. Parkhurst. Published by the Author, Cleveland (copyright 1918). Cloth, 6x9 in., 203 pp., 7 tab. $3.

A textbook prepared to accompany the author's course of thirty lectures, delivered during 1917-18 at the Case School of Applied Science.

A Short Handbook of Oil Analysis. By Augustus H. Gill. 8th ed., revised. J. B. Lippincott Co., Philadelphia, (copyright 1918). Cloth, 5x8 in., 209 pp., 9 illus.

This well-known manual is designed to provide a concise account of the methods of applying the usual physical and chemical tests to oils. The eighth edition has been revised, descriptions of some new forms of apparatus included and some minor tests and new methods added.

Technical Mechanics. By Edward R. Maurer. Statics and Dynamics. 4th ed., revised and enlarged. John Wiley & Sons, Inc., New York, 1917. Cloth, 6x9 in., 381 pp., 178 illus. $2.50.

A theoretical mechanics written for students of engineering, in which each subject discussed has a direct bearing on some engineering problem. The book thus differs from those commonly called theoretical mechanics, and is, on the other hand,

dissimilar to books commonly entitled applied mechanics. The fourth edition has in addition 176 more problems and the modification of the articles on axle reactions, efficiency of machines, hoists, gyrostats kinetics of plane motion, rolling resistance, kinetics of a body with a fixed point, and the dynamics of any motion of a rigid body.

Text Book of Advanced Machine Work. By Robert H. Smith. 4th ed. Revised and enlarged. Prepared for Students in Technical, Manual Training, and Trade Schools, and for the Apprentice and Machinist in the Shop. Industrial Education Book Co., Boston (copyright 1916). Cloth, 5x8 in., 648 pp., 680 illus., 44 tab. $3.

A continuation of the author's Principles of Machine Work. This volume treats of engine-lathe work, drilling and boring machines, grinding, planing, milling, gear cutting and tool making. Careful explanations are given in each case.

War Administration of the Railways in the United States and Great Britain. By Frank Haight Dixon and Julius H. Parmelee. Carnegie Endowment for International Peace, Division of Economics and History. Preliminary Economic Studies of the War. Oxford University Press, New York, 1918. Paper, 7x10 in., 155 pp. $1.

An account of the methods used in the two countries and of the results achieved prior to December, 1917, during the period when the American railways were voluntarily coöperating with each other. The authors present a simple narrative, without attempting to draw conclusions.

War-Time Control of Industry. The Experience of England. By Howard L. Gray.. The Macmillan Co., New York, 1918. Cloth, 5x8 in., 307 pp. $1.75.

A summary of the development and status of governmental control of industry in Great Britain, arranged to show its successive stages. Part of the information was collected for the Commercial Economy Division of the Council of National Defense. The book concludes with a comparison of English and American experience.

The Petroleum and Natural Gas Register. A Directory of the Petroleum and Natural Gas Industries in the United States, Canada and Mexico. The Oil Trade Journal, New York, 1917-1918. Cloth, 9x12 in., 548 pp. $12.

This work is based on statements made by officials of the companies listed, and gives the usually needed information as to properties, capital stock, officers, etc. The price includes an annual subscription to the *Oil Trade Journal*, in each issue of which supplemental data are to be published.

LIBRARY ACCESSIONS

AIRPLANE BUILDING. List of books in collection of Brooklyn Public Library, January 1918. *Brooklyn, 1918.* Gift of Brooklyn Public Library.

ALCOHOL AS A SOURCE OF POWER. (South Australia. Dept. of Chemistry. Bulletin No. 8.) *Adelaide, 1917.* Gift of South Australia Dept. of Chemistry.

APPARENT DIELECTRIC STRENGTH OF VARNISHED CAMBRIC. By A. E. Kennelly and R. J. Wiseman. Reprinted from *Electrical World*, Dec. 15, 1917. Gift of Massachusetts Institute of Technology, Electrical Engineering Dept.

ASCERTAINMENT OF MACHINERY VALUES AND LOSSES. Read before the Insurance Society of New York, Jan. 11, 1916. By John Hankin. Gift of Insurance Society of New York.

BOLIVIA, THE REPUBLIC OF—OFFICIAL INFORMATION AND STATISTICS, SUMMARIZED BY JULIO ZAMORA. *New York, n. d.* Gift of Bolivia, Minister of Foreign Relations.

CALIFORNIA RAILROAD COMMISSION. Opinions and Orders, Dec. 1, 1916-March 31, 1917. vol. XII. *Sacramento, 1917.* Purchase.

CHAMBER OF COMMERCE OF THE UNITED STATES OF AMERICA. Year Book, 1917. *Washington, 1917.* Gift of Chamber of Commerce.

THE CHEMICAL CONSTITUTION OF THE PROTEINS. By R. H. A. Plimmer. Part 1, Analysis. Longmans, Green and Co., *New York, 1917.* Boards, 6 x 10 in., 174 pp., 7 illus., $1.80. Gift of the publishers.

CHEMISTRY OF LINSEED OIL. By J. Newton Friend. *London, 1917.* Purchase.

COTTON PRODUCTION AND DISTRIBUTION, 1916-17. U. S. Bureau of the Census, Bulletin 135. *Washington, 1918.* Purchase.

CURTISS STANDARD JN4-B MILITARY TRACTOR. Handbook, 1917.

CURTISS STANDARD MODEL V-2 AERONAUTICAL MOTOR. Handbook, 1917.

CURTISS STANDARD MODEL OX AERONAUTICAL MOTOR. Handbook, 1918.

CURTISS STANDARD MODEL OX 5 AERONAUTICAL MOTOR. Parts list. *Buffalo, 1917-18.* Gift of Curtiss Aeroplane & Motor Corporation.

DESIGN AND CONSTRUCTION OF INDUSTRIAL BUILDINGS. By Moritz Kahn. *London, 1917.* Purchase.

DUST EXPLOSIONS AND FIRES IN GRAIN SEPARATORS IN THE PACIFIC NORTHWEST. (U. S. Dept. of Agriculture. Bulletin No. 379.) *Washington, 1916.* Purchase.

THE EXAMINATION OF MILK FOR PUBLIC HEALTH PURPOSES. By Joseph Race. John Wiley & Sons, Inc. *New York, 1918.* Cloth, 5 x 8 in., 224 pp., 4 illus., $1.75. Gift of the Publisher.

FACTOR OF SAFETY OF WIRE ROPES USED FOR WINDING IN MINE SHAFTS. By J. A. Vaughan. Reprinted from the *Journal of the South African Institution of Engineers*, Nov. 1917. Gift of author.

FOAMING OF BOILER WATERS. (South Australia. Dept. of Chemistry. Bulletin No. 5.) *Adelaide, 1917.* Gift of South Australia, Dept. of Chemistry.

FREIGHT HANDLING AND TERMINAL ENGINEERING. Vol. 2; 3; Vol. 4, No. 1. *New York, 1916-18.* Gift of H. McL. Harding.

FRESH WATER BIOLOGY. By Henry Baldwin Ward and George Chandler Whipple with a collaboration of a staff of specialists. John Wiley & Sons, Inc. *New York, 1918.* Cloth, 6 x 9 in., 1111 pp., 1547 illus., $6. Gift of the publisher.

THE GERMAN UNION OF TECHNICAL AND SCIENTIFIC SOCIETIES. By Sir Robert Hadfield. *January, 1918.* Gift of Sir Robert Hadfield.

GOLD DEPOSITION IN THE BENDIGO GOLD FIELD, THE FACTORS INFLUENCING AUSTRALIAN. Advisory Council of Science and Industry. Bulletin No. 4. *Melbourne, 1917.* Gift of Advisory Council of Science & Industry.

GREAT BRITAIN. DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH ADVISORY COUNCIL. Report on the sources and production of iron and other metalliferous ores used in the iron and steel industry. *London, 1918.* Gift of A. D. Flinn.

HEAT TREATMENT OF HIGH SPEED STEEL. By Garnet W. McKee. Ed. 3. *n. p. n. d.* Gift of Eclipse Fuel Engineering Company.

HEAT TREATMENT OF STEEL IN GAS FURNACES. By Garnet W. McKee. Ed. 4. *Rockford, Ill., 1918.* Gift of Eclipse Fuel Engineering Company.

HELICOPTER FLYING MACHINE. By J. Robertson Porter. *London, 1911.* Purchase.

HOW BALTIMORE MANUFACTURERS CAN DO BUSINESS WITH THE GOVERNMENT. SUGGESTIONS AND INFORMATION. Gift of the Civic and Industrial Bureau of the Merchants and Manufacturers Association.

HYDRAULIC TURBINES. I. P. Morris Company, Hydraulic Dept. Bulletin No. 4. The William Cramp & Sons Ship & Engine Building Co. *Philadelphia, 1915.* Gift of F. H. Rogers.

HYDROMETRIC SURVEYS (STREAM MEASUREMENTS) FOR 1916. Canada. Department of the Interior. *Ottawa, 1917.* Gift of Department of the Interior.

INDUSTRIAL PLANT CONSTRUCTION. *Buffalo, 1918.* Gift of The John W. Cowper Company.

INDUSTRIAL RESEARCH IN CANADA. By J. C. McLennan. *Toronto, 1916.* Gift of Royal Canadian Institute.

LAND AND MARINE DIESEL ENGINES. Ed. 2. By Giorgio Supino. *London, 1917.* Purchase.

L'INDUSTRIE DE L'ACIER EN FRANCE. By J. Tribot-Laspiére. *Paris, 1916.* Purchase.

LIQUEFYING AIR BY THE LINDE THROTTLED RELEASE VALVE AT ATMOSPHERIC PRESSURE AND THE PLACE PROCESS OF 4-STEP RELEASE WITH LIQUEFACTION AT THE CRITICAL PRESSURE. Both systems availing of the Joule-Thomson equation for expanding air without recoverable mechanical work. By J. F. Place. *Glenridge, 1918.* Gift of J. F. Place.

MAGNESIA ASSOCIATION OF AMERICA. Anniversary advertising portfolio of "85% Magnesia" 1917. *Philadelphia, 1917.* Gift of Association.

MECHANICAL EQUIPMENT OF BUILDINGS. Vol. II—Power Plants and Refrigeration. By Louis Allen Harding & Arthur C. Willard. John Wiley & Sons. *New York, 1917.* Purchase.

MEMORANDUM RESPECTING THE QUALITY OF SPELTER SUITABLE FOR THE MANUFACTURE OF CARTRIDGE BRASS AND OTHER HIGH-GRADE BRASS. By W. R. Ingalls. *New York, 1917.* Gift of author.

MERCHANTS' ASSOCIATION OF NEW YORK. Summary of laws and ordinances applying to streets and public places in the City of New York, April 15, 1916, and the duty of police officers and citizens in connection therewith. *New York, n. d.* Gift of Merchants' Association of New York.

MUNITION WORKERS, BOOK HELPS FOR. Gift of Brooklyn Public Library.

NATIONAL PHYSICAL LABORATORY. Notes on screw gages by the staff of the gage testing department. *Teddington, 1917.* Gift of National Physical Laboratory.

THE PHYSICAL CHEMISTRY OF THE PROTEINS. By T. Brailsford Robertson. N. Y. and Lond. Longmans, Green & Co., *New York, 1918.* Cloth, 6 x 9 in., 483 pp., 8 illus., $5. Gift of the publisher.

THE POWER COMPANY AND THE DISTRIBUTION OF ELECTRICAL ENERGY. By Wm. C. L. Eglin. (Supplement to Current News, April, 1917.) Gift of author.

THE PRESERVATION OF WOOD. By A. J. Wallis-Tayler. *London, n. d.* Purchase.

PRODUCTION OF HIGH TEMPERATURE AND ITS MEASUREMENT. By E. F. Northrup. Reprinted from the Transactions of the Faraday Society, v. 13. Gift of Alfred D. Flinn.

REFRACTORY MATERIALS: THEIR MANUFACTURE AND USES. By Alfred B. Searle. *London, 1917.* Purchase.

REINFORCED CONCRETE CARGO STEAMSHIP "FAITH," THE LARGEST CONCRETE VESSEL AFLOAT. Gift of Portland Cement Association.

SCIENTIFIC RESEARCH IN RELATION TO COTTON AND THE COTTON INDUSTRY. Manchester, Provisional Committee on Research and Education for the Cotton Industry, 1917. Gift of A. D. Flinn.

THE SHIP-BUILDER'S LIBRARY, BOOKS ON NAVAL DESIGN AND CONSTRUCTION TO BE FOUND IN THE BROOKLYN PUBLIC LIBRARY. August, 1917. Gift of Brooklyn Public Library.

THE SYNTHETIC DYESTUFFS AND THE INTERMEDIATE PRODUCTS FROM WHICH THEY ARE DERIVED. Ed. 3. By J. C. Cain and J. F. Thorpe. *London, 1917.* Purchase.

THEORY OF THE SUBMARINE TELEGRAPH AND TELEPHONE CABLE. By H. W. Malcolm. *London, 1917.* Purchase.

TRADE CATALOGUES

ADJUSTABLE SPRAY HEADS. Bulletin No. 601. Simplex "Seatless" Blow-Off Valve. (Descriptive circular.) Yarnall-Waring Company. Philadelphia, Pa.

ADVANTAGES OF SELF-OPENING DIES. 1917. Greenfield Tap and Die Corporation. Greenfield, Mass.

AMMONIA FITTINGS AND ACCESSORIES. (Catalogue.) De La Vergne Machine Company. New York City.

AUTOMATIC EQUALIZING STOP AND CHECK VALVES. Booklet. Jenkins Bros. New York City.

AUTOMATIC REFRIGERATION WITH ELECTRIC POWER, descriptive booklet. Automatic Refrigerating Company. Hartford, Conn.

BOOKLET JUST ABOUT BOILERS. 1917. Badenhausen Co., Philadelphia, Pa. 3rd Enlarged Edition, 1917.

BOOKLET JUST ABOUT MARINE BOILERS. Badenhausen Co., Philadelphia, Pa. 1917.

CATALOGUE DESCRIBING RILEY UNDERFEED STOKERS. Sanford Riley Stoker Co., Worcester, Mass.

CATALOGUE OF BUCKEYE BARRETT OIL ENGINES FOR OPERATING ON LOW GRADE FUEL OIL. Buckeye Machine Co., Lima, Ohio.

CATALOGUE OF THE BIGELOW-HORNSBY WATER TUBE BOILER. The Bigelow Co., New Haven, Conn.

CENTRIFUGAL PUMPS. 1918. Bulletin 108-B. Wheeler Condenser & Engineering Co., Carteret, N. J.

CHAIN DRIVEN MOTOR TRUCKS AND TRACTORS. Book No. 359. Link-Belt Company. Chicago, Ill.

CIRCULARS COVERING DE MANT PRECISION BENCH LATHE. De Mant Tool & Machine Company, Inc. New York City.

DIAMOND SOOT BLOWERS FOR WATER-TUBE BOILERS. 3rd Ed., 1918. Bulletin No. 119. Diamond Power Specialty Company. Detroit, Mich.

ELECTRIC ARC WELDING AND CUTTING. The Wilson System. Manual No. 1, March, 1918. The Wilson Welder & Metals C New York City.

ELECTRIC STORAGE BATTERY INDUSTRIAL TRUCKS AND TRACTORS. Catalog No. 117. Elwell-Parker Electric Co., Cleveland, Ohio.

ELECTRIC WELDING. 1916. Catalog No. 1. The Wilson Welder & Metals Co., New York City.

ELECTRICAL SUPPLIES. 1917. General Catalog No. 20, With Price List and Discount Sheet. Monarch Electric & Wire Co., Chicago, Ill.

HAJOCA BATHS. Supplement No. 2 to Catalog R. Haines, Jones & Cadbury Co., Philadelphia, Pa.

HISTORY OF THE PLANER. 1751-1916. Cincinnati Planer Co., Cincinnati, Ohio.

HOW TO SAVE COAL. April, 1918. Bailey Meter Co., Boston, Mass.

JEFFREY STORAGE BATTERY LOCOMOTIVES FOR INDUSTRIAL PLANTS. Catalog No. 231. Jeffrey Manufacturing Co., Columbus, Ohio.

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LUDLUM STEEL—CARBON AND ALLOY TOOL STEELS. Ludlum Steel Co., Watervliet, N. Y.

MELTING FURNACES AND COMPLETE FOUNDRY INSTALLATIONS. Frederic B. Stevens, Detroit, Mich.

PIPE TOOLS. Catalog No. 38. Greenfield Tap and Die Corporation. Greenfield, Mass.

ROPE AND TWINE INFORMATION. 79 pp. Chatfield & Woods Co., Cincinnati, Ohio.

STOCK LIST OF CUTTERS. April 15, 1918. Cleveland Milling Machine Co., Cleveland, Ohio.

SUPPLEMENT No. 1. Feb., 1918. Containing Additions and Improvements to the O-B Materials, Listed in General Catalog No. 16. Ohio Brass Co., Mansfield, Ohio.

THE ECONOMY OF MECHANICAL FIRING. Moloch stoker, type "H." Moloch Stoker Company. Chicago, Ill.

THE LABOR SAVER, No. 82. Feb., 1918. Stephens Adamson Manufacturing Co., Aurora, Ill.

THE POWELL PATENT PLANER. "Hy-Speed Cut". (Descriptions). Powell Machine Co., Worcester, Mass.

THE PUMP THAT "MANISTEE" BUILDS. Booklet. Manistee Iron Works Co., Manistee, Mich.

THE STUB TOOTH GEAR. Ed. 4. 1918. Fellows Gear Shaper Company. Springfield, Vt.

VERTICAL TYPE ALTERNATORS. Bulletin No. 176. January, 1917. List No. 150. Users of vertical alternators. Chart showing range of sizes and speeds of all vertical alternators. Electric Machinery Company. Minneapolis, Minn.

WESTINGHOUSE ELECTRIFICATION DATA. Feb., 1918. Vol. 2, No. 2.

WESTINGHOUSE LIGHTNING ARRESTERS, 1918, Catalogue 1-A; PORTABLE HOIST AND DUMBWAITER MOTORS, Leaflet 1395; TYPE C AUTOMATIC STARTERS WITH COUNTER E. M. F. ACCELERATION, Leaflet 1483; TYPE KN OVERLOAD RELAY, Leaflet 1728. Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

WILLIAMS COAL CRUSHERS FOR POWER PLANTS. Bulletin No. 196. Williams Patent Crusher & Pulverizer Co., Chicago, Ill.